Construction and Layout of High Tension Equipment—*Theory and Operation of the Split-Phase Magnet and other engineering articles together with regular departments devoted to commercial and operating practice.*

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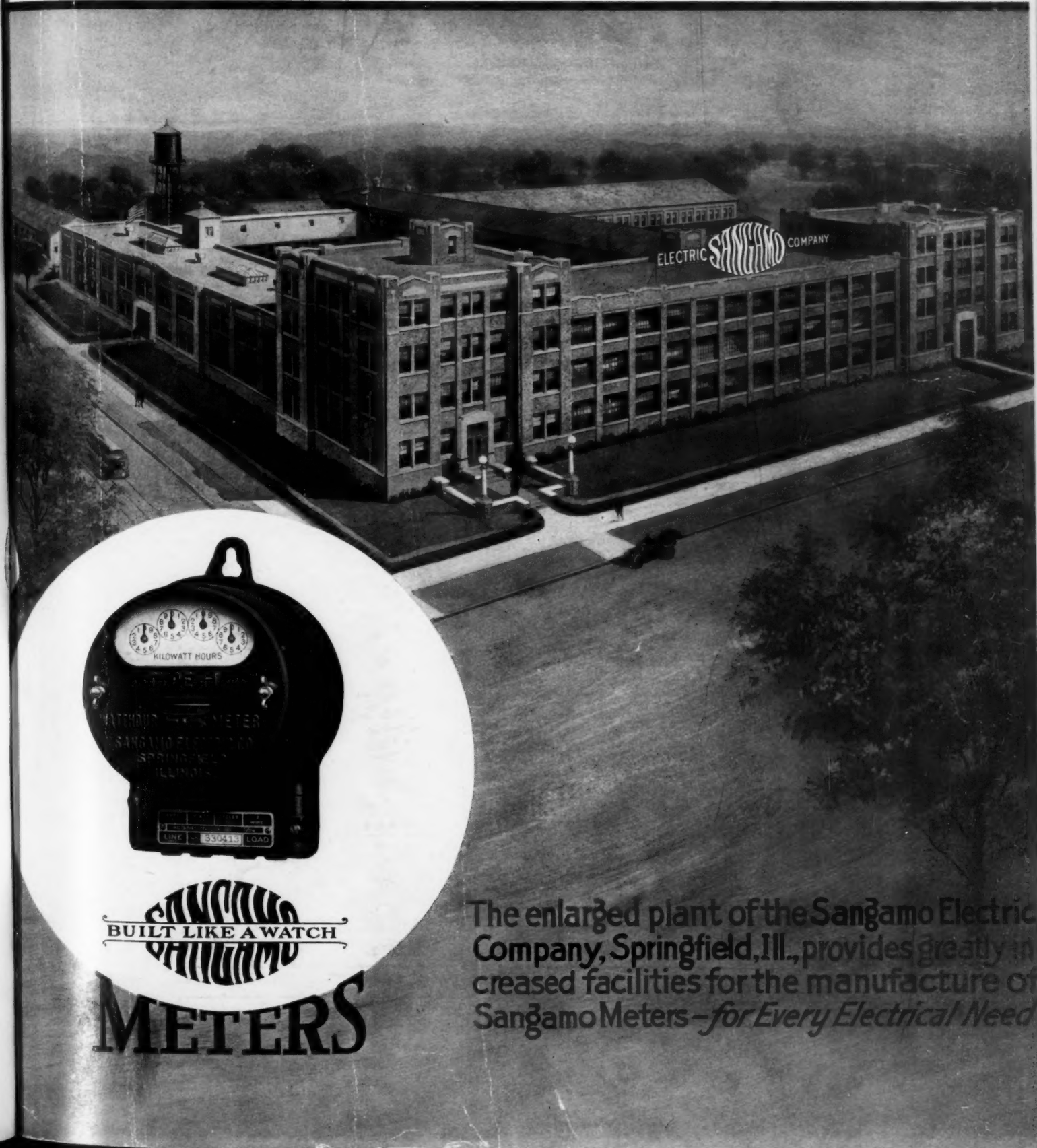
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Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.
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Valuation and the A. I. E. E.

VALUATION implies a search for assets, visible and invisible. Its ultimate aim is a presentation of totals representing the value of the property. Usually these totals appear in a rate-making case. And upon the acceptance of them by commission or court, the earning capacity of the plant may depend. The central station executive who has engaged in a contest before a public service commission in which his rates were the issue and the preservation of his earning power was at stake has no illusions concerning the importance of the proceedings. Neither does the engineer who made the valuation during laborious months or years entertain any other idea than that his product is vital evidence. It is evidence of vital character. This being granted, it is surprising that the action of the American Institute of Electrical Engineers in devoting the meeting of last week to the problem of valuation did not inspire a more general discussion of the leading principles involved. The opportunity was provided by the Institute but it was not accepted. This is one of the occasions on which the members will look back with regret as an invitation declined. For the discussion that did take place the membership as a whole will feel grateful; and they will hope for a later meeting with clear statements of what electrical engineers believe and what they reject on this large question.

For Progress in Industrial Research

WE are rapidly learning in this country that the work of research is a matter of national concern. The achievements of private initiative are leading to greater private effort, and both governmental and educational institutions are adding to their facilities. It is clear that a much-needed lesson is being taken to heart. The present rate of advancement is encouraging in tangible results, but it is amazing in its promise for the future. To the earlier movements in this direction there is now added the elaborate plan of President Nicholas Murray Butler of Columbia University. Dr. Butler foresees the return of every dollar put into a great research laboratory to American industry many times over in the course of a very few years. The number of institutions that can calmly invite so large a sum as $6,000,000 for such an enterprise is limited. But the spirit and will for such developments, without regard to the scale on which they are undertaken, will count in the aggregate. We stand face to face with a Europe which will be organized with superb efficiency after the war. Shall we be equipped or shall the prosperity given by the war across the seas blind our eyes to the great need of scientific direction and research for every class of industry throughout the land?

Split-Phase Magnets

THE split-phase magnet is a device for producing a quiet holding pull from alternating-current excitation. A number of such devices have already been designed and employed. The subject has been brought forward on more than one occasion in past numbers of the ELECTRICAL WORLD. The theoretical discussion which is presented in an article by F. Hymans in this issue, is, however, more extensive and detailed than before. A tabulated and plotted series of actual observations on such magnets would be useful in conjunction with the theory, and perhaps such actual quantitative information is contemplated for presentation at some time in the future.

It is interesting to observe that the type of split-phase magnet here described behaves very differently from the ordinary direct-current magnet. An ordinary direct-current magnet has its maximum pull in the holding position, and lessens its pull very rapidly as the distance between the attracting surfaces is increased. In this split-phase magnet, however, the starting pull appears to be considerably greater than the holding pull. It would, therefore, seem possible to produce, when necessary, a combined alternating-current and direct-current magnet which should exert substantially constant pull over the entire range from the opening to the closing of its jaws. Perhaps the same result could be obtained with alternating-current excitation only by combining two models of split-phase magnet with opposite characteristics in this respect.

Losses in Armored Cable

WHEN an alternating current is carried by a long straight insulated wire, we know that the alternating magnetic field set up by the current tends to increase the current density near the surface of the conductor and to diminish it in the central or axial regions, thereby increasing the effective resistance of the conductor, and the power loss accompanying a given current strength. This is the ordinary phenomenon of skin effect. If the long straight insulated wire is inclosed in a lead sheath, then the alternating magnetic flux surrounding the wire will cut the substance of the sheath concentrically and set up additional eddy-current loss. If the return current is carried by the sheath there will also be skin effect in both conductor

and sheath. Again, if the insulated cable, instead of being in the form of a long straight wire, is arranged in the form of a rectangular loop, the loop will carry an alternating magnetic flux, and thus set up a secondary current in the sheath, if the latter is shorted so as to form a closed conducting path. This secondary action will be superposed upon the skin effect already considered. The magnitude of the secondary current will depend on the area of the loop, or the distance between the going and returning cables. The relation is, however, not likely to be simple, owing to the disturbances introduced by the secondary magnetic flux. Finally, if one or more steel tapes are wound over the lead-covered cable by way of armor, the alternating magnetic flux in these tapes tends to be relatively considerable, with correspondingly intensified secondary currents and power losses. The effective resistance with steel tapes cannot increase steadily with the current, but may be expected to pass through a maximum depending upon the maximum permeability of the steel, which is brought into effect at some particular value of the current passing through the cable.

The article by Mr. W. I. Middleton in this issue on losses in cables with armored steel tapes gives interesting and useful quantitative information concerning these losses as derived from tests on two particular sizes of cable. It is evident that it makes a great difference whether a loop of such lead-covered cable has its sheath open or shorted, but that it makes relatively little difference whether the steel tapes are open or shorted. The formulas controlling these interesting results so as to include both skin effect and transformer action are probably complicated, but it would be well worth while investigating the matter step by step to ascertain whether the results might not be approximately represented by some relatively simple formula. If so, it should not be necessary to make elaborate tests on each new size of steel-taped cable. It might be possible to predict the losses with satisfactory precision from the dimensions of the cable and the magnetic properties of the steel tape.

Co-operation of the Manufacturers

THE broad meaning which attaches to "co-operation" is plainly understood in the electrical industry. Without a common purpose and union for the determined advancement of that purpose the different branches of the industry would not have attained their present level of output and enormous gross earning power. But within that greater sphere in which co-operation is recognized as necessary for the welfare of all, we have an industry which is composed of separate and distinct branches. Familiar as these parts of the electrical corporate body are, men whose affiliations are in one branch do not always appreciate the work which is being done to render another branch more productive. The Associated Manufacturers of Electrical Supplies, measured by its attainments in the very brief period of life which it has had to this time, is a great power in the industry. But its potential influence for the future is of even greater importance. President R. K. Sheppard, who describes in another part of this issue the form of organization and the underlying principles controlling the work, illuminates in a new way the far-reaching advantages of earnest co-operation.

Daylight Saving

WITHIN the past few weeks the season of daylight saving, wherever it has been tried, has come to an end, and the clocks have gone back to their normal standing. The first season's trial is over, with the net results rather hard to estimate. Such reports as have come in, particularly from abroad where the scheme has been well-nigh universal, indicate that the result as a whole has been rather satisfactory, but how much of real economy has been secured it is quite impossible to tell. Perhaps at this particular time, when the war has thoroughly disorganized all the customary habits of the peoples involved, a fair trial from the standpoint of real saving in artificial light is rather impracticable. It certainly cannot be made in a way fairly comparable with that pertaining to normal life during times of peace. A most interesting feature of the case is that on the whole the popular verdict has been in favor of the experiment. The change was made without any material amount of friction and everybody seemed at once to settle into the new régime. The same facility was shown in changing back again a few weeks ago, so that it has been effectively proved that so far from creating serious confusion a shift in the clocks, at least to the extent of an hour in either direction, can be made without upsetting ordinary affairs to any material degree. Certainly the difficulty was much less in this instance than in establishing the standard time belts some thirty years ago, very possibly for the reason that in inaugurating daylight saving the whole power and influence of the government was exerted to make the change complete, whereas in organizing standard time the movement was to a very large extent voluntary and greatly hindered by local influence.

It is too early yet to speak definitely of the net effects of daylight saving on the public utilities which supply lighting service. We are inclined to believe that it will be much smaller than was anticipated. While in particular localities the loss will probably stand out somewhat conspicuously, in other sections where it may turn out to be negligible we shall hear comparatively little. The experience which has been gained does not, however, make it clear that the movement would be as successful here as it has been in Europe. There has been vigorous protest from places near the edges of the time belts at running the affairs of life half an hour off sun time. By increasing this discrepancy to an hour and a half, there is at least considerable opportunity for inconvenience.

It may be that the plan will be worked in this country by another season, but it is a case where caution is peculiarly advisable. If daylight saving after investigation turns out to be an unqualified success where it

has been tried, this would be reason enough for trying it here, provided some way can be found for persuading 100,000,000 people scattered over 3,000,000 square miles voluntarily to make a change which might or might not prove profitable or convenient.

High-Tension Construction

ELECTRIC power transmission at high voltage is to-day so much of a commonplace matter that one hardly stops to consider the details which go to make up the success of an installation. Only those who are in close touch with transmission realize how, through the past decade with general principles of operation and even voltages of transmission not varying much, there has been a constant improvement in apparatus details, which has added very much to the reliability of the plant. The article by M. M. Samuels in this issue takes up some of these details which have proved important in the construction and operation of high-tension plants, and brings to view the really considerable changes which have improved the art of power transmission within a comparatively short time. In particular he deals with the modifications of transformer and switch practice which have had a powerful influence on the success of high-voltage transmission. One very notable change of comparatively recent years has been the increasing use of three-phase units. These really belong to the very early history of the art in Germany. American engineers for a long time were very cautious in adopting them, since all one's eggs were put in a single basket, and it seemed wiser to use separate transformers for each phase so that the plant might be worked on an emergency connection in case a single transformer failed. The introduction of improved lightning arresters, particularly the electrolytic type, have in considerable measure removed the danger of burn-outs and encouraged the use of highly efficient and economical three-phase transformer units. Whether these or the separate transformers are chosen, however, depends somewhat on the size of the plant and the character of service. A sufficiently large installation can very well carry one or more three-phase units in reserve while a small plant might still find it advisable and economical to employ separate transformers.

Mr. Samuels draws attention to one feature of transformer building to which more attention ought to be paid, namely, the adoption of, if not a standard form, at least a general type of design, so that a reasonable amount of space allotted, let us say, for a 1000-kw. transformer, would really accommodate this rating from whatever company the transformer might be purchased. Perhaps the best policy in station design, bearing in mind this difficulty, is to allow sufficient room to accommodate any particular type of apparatus that is likely to be chosen. Great compactness is sometimes necessary in a power plant, but rarely in the case of hydroelectric plants for high-voltage transmission. A crowded high-tension plant is very unpleasant to operate and it is not always cheap in first cost since the outer shell of the station is, generally speaking, the least expensive item of the total construction, and a few square feet judiciously added here and there are hardly perceptible in the total, while the extra room may greatly facilitate the installation and working of the apparatus. All that is true of transformers in this respect is also true of the switching devices. A little spare space makes the plant easier to get at in case of emergency and easier to repair at comparatively low cost. The actual cost of conductors in a station is generally not great compared with the cost of getting them into safe positions when an attempt is made to save room. Switching apparatus is a frequent source of trouble in station operation, and not only is it desirable to select comparatively simple and easily-operated devices, but to put them where the connections, including disconnecting switches, are conveniently placed and easily inspected. Mr. Samuels' paper gives some exceedingly useful suggestions on these important matters, and we emphasize those features which touch upon simplicity in station design. The recent developments of high-tension transmission have been very helpful in this particular, since the linkage of many plants into a single network makes it possible for one plant to serve as the reserve for another, instead of adopting intricate and costly equipment for the sake of dealing with the largely hypothetical difficulties of operation which might arise in a single plant. The important thing is simplicity and security in the operation of the whole system, and that interchangeability which considers the network as a whole rather than the separate parts of a single station. The problem of design must be looked at broadly, and much of the detail which once pertained to the operation of a single plant can now be planned merely with reference to the interconnection of stations.

The Coming Issues

IN the next issue of the ELECTRICAL WORLD, which is the number for November devoted to commercial topics, a leading article by S. M. Kennedy, general agent of the Southern California Edison Company, will discuss the value of the electric range from standpoints of the central station and consumer. A great deal of information will be presented to show the value of the cooking load and features of development work that are necessary to secure it. The third article of the series on export trade for electrical manufacturers and jobbers will also appear in that number. The articles of the first issue of December, dated Dec. 2, will deal with problems of public policy in the operation and management of utilities and discuss broad business questions. The second issue of the month, as usual, will contain articles on different phases of station and operating practice. The November number of ELECTRICAL MERCHANDISING, which was issued this week, extends to the electrical trade numerous suggestions for Christmas selling and reflects the spirit of America's Electrical Week.

Chronicle of Events of the Industry and of Important Movements in the Field

NEWS OF THE WEEK

Reports of Conventions and Meetings of Electrical Associations and Societies

HUNDRED-POINT CAMPAIGN FOR JOVIAN MEMBERS

During Next 30 Days Every Jovian Will Be Interviewed Concerning the Value of the Order and the Necessity of Raising the Dues

At the Indianapolis convention of the Jovian Order a new financial plan for the order was agreed upon, including an increase of dues to $4 a year. To put this new plan into effect a nation-wide campaign is being launched by the "hundred-point committee" of the Jovian Order. The United States has been divided into six great divisions under the leadership of a general chairman with six advisory chairmen. During the next thirty days the general chairman, Martin J. Wolf of St. Louis, in consultation with representative Jovians throughout the United States, has arranged to have every Jovian in the forty-eight states reached and interviewed personally, first, concerning the value of the Jovian Order to individual members and to the industry, and second, as to the necessity of raising the dues to $4 a year as voted at the Indianapolis convention.

The campaign has been worked out in considerable detail, and the six main divisions are each handled through state chairmen, who in turn have organizations of city chairmen and local committee men. The detail machinery for handling the campaign has been well developed. Folders containing a complete description of the "hundred-point committee" have been prepared, special stationery is provided, and the whole movement is one in which every Jovian will be interested.

NEW ERA IN AMERICAN INDUSTRIAL MANUFACTURING

President Harding at Annual Meet of Electric Power Club Emphasizes Standardization and Uniform Cost Accounting

The seventh semi-annual meeting of the Electric Power Club, an organization comprising the most prominent manufacturers of motors, transformers and industrial control apparatus of the country, was held at Hot Springs, Va., on Wednesday, Thursday and Friday of this week. An elaborate program indicative of the scope of the organization and of its value to the electrical industry was prepared. The chief function of the organization being the standardization of electrical machinery and the promotion of a spirit of co-operation among its members for the improved production and increased distribution of electrical machinery and apparatus, naturally reports bearing on these and allied subjects were very much in evidence. Eight morning and evening sessions were necessary to dispose of the work consisting chiefly of reports of standing, sub- and special committees as follows: membership, entertainment, standardization, public policy, publicity, fractional-horsepower motor, large-power motor, direct current generator, alternating-current generator, general engineering recommendations, buffing and grinding motors, nomenclature, mining locomotive, transformer section, industrial control section, underwriters, cost accounting, motor application, manufacturers' council delegates, U. S. Bureau of Mines and U. S. Bureau of Standards.

Chief interest in the opening session centered around the presidential address of E. R. Harding of the Holtzer Cabot Electric Company who reviewed the work of the organization and what it has accomplished. The first specific work on commercial motor and dynamo standardization that has ever been sent out to the public in general has been compiled by the Electric Power Club and has met with cordial favor. The association now has committees working on matters of standardization in connection with the U. S. Bureau of Standards, the Association of Railway Electrical Engineers, the inspection departments of factory mutual insurance companies, the American Institute of Electrical Engineers and the National Electric Light Association. Conference committees have been appointed by both of the latter bodies to meet a like conference committee from the Electric Power Club and expedite work. Through the efforts of the U. S. Bureau of Mines' committee there has been furnished and installed at the testing laboratories of the Bureau of Mines at Pittsburgh, Pa., a very complete equipment for the testing of explosive proof motors for use in coal mines.

The benefits that may accrue to every motor manufacturer who will enter actively into the task of the study, the development and the adaptation of a uniform cost accounting system, were outlined by President Harding who said that "True cost accounting is the financial heart of the business corporations of this country. It is a guarantee to the stockholder. It is a guarantee of credit risks. It is a guarantee against receiverships." The Electrical Manufacturers Club, the Associated Manufacturers of Electrical Supplies and the Electric Power Club through the Electrical Manufacturers' Council have taken up the subject of uniform cost accounting, and the council has appointed an advisory committee from the three associations whose first work, primarily, will be to standardize accounting terminology. C. E. Patterson, controller of the General Electric Company, is chairman of that committee.

In the estimation of Mr. Harding the country has entered on a new era in industrial manufacturing—the era of scientific development, uniformity and co-operation. The industry is standardizing on product and manufacturing methods, and it is employing research laboratories. Mr. Harding said, "It is a moral right that every corporation should earn an adequate profit not only to take care of its growing needs but also to pay a commensurate dividend on the capital invested."

To show that the Electric Power Club has been building upon a firmer foundation than possibly many have anticipated, President Harding emphasized the following conclusion: "That the Electric Power Club through its scientific treatment of standardization and commercial practices, its study of manufacturing methods and uniform cost accounting is building in the only true way to assure a lasting and an adequate profit to the motor industry."

In its general report the standardization committee rehearsed the work already completed by it and elaborated on the work now confronting it. During the year it sensed the need of closer co-operation with other

associations more than ever in order to obtain prompt harmonious and concerted action on some matter of interest to all; co-operation on matters of standardization in which more than one body is interested, or to know just what should be the proper line of demarcation in the work of the different associations. Although the Electrical Manufacturers' Council is useful in coordinating the work of the electrical manufacturing interests there is as yet lacking some specific procedure for reaching other associations. Preliminary negotiations have already been started with the American Institute of Electrical Engineers and the National Electric Light Association.

The Bureau of Standards committee told in its report of the work of the Electric Power Club in getting the Bureau of Standards to modify the second paragraph of Rule 300C, or to delete it entirely. The committee considers that the National Safety Code is in the main in very satisfactory shape but that difficulty can be anticipated in the administration of the rules. So far as the committee can learn there is no machinery provided by the Bureau of Standards, or by State governments to determine whether apparatus meets the general requirements of the code. On Wednesday evening, A. H. Moore of the General Electric Company, read a paper on "Shaft Diameters for Standard Industrial Power Motors."

EFFECT OF ELECTION ON LIGHTING UTILITIES

Cleveland Voters Approve Bond Issue for Municipal Lighting Plant—Illinois Election May Result in Separate Commission for Chicago

Each year voters in a number of cities have the opportunity of voting funds for projects which may seriously embarrass local lighting companies. Attention this year was focused on Cleveland, Ohio. In that city the voters, on Nov. 7, approved a bond issue of $1,750,000, from the proceeds of which additions to the building and equipment of the municipal light plant will be made. Light Commissioner W. E. Davis has said since the election that this money will furnish equipment sufficient to serve from 15,000 to 20,000 additional homes. He will proceed in its expenditure according to instructions from the City Council.

After one of the most strenuous election campaigns ever waged in Springfield, Ill., the city will have a new generator. The proposition, although bitterly contested by the utilities company, carried by a two-to-one vote. The generator has been ordered constructed at once by the Kerr Tribune Company of Wellsville, N. Y., and is expected to arrive in Springfield about Jan. 1.

In Illinois the election of Col. Frank O. Lowden as Governor presages the establishment of another public utility commission in the State, since Col. Lowden has declared that he believes Chicago should rule its own utilities, but at the same time objects to turning the rule back into the hands of the Chicago City Council. Seemingly his ideas point toward the formation of a commission for Chicago alone, perhaps subordinate to the one now in existence.

There will probably be some sweeping changes in the policies of the Sanitary District of Chicago, since five of the nine members of the board of control are now Republicans, whereas the majority were formerly Democrats. The newly-elected members of the board are Charles H. Sergel, the president-elect of the board, and James H. Lawley and Matthias Mueller.

The proposition to consolidate the control of all Chicago's parks, which, among other things, control park and boulevard lighting, was defeated by a majority of more than 110,000 votes. This proposition, had it passed, would have necessitated abolishing two of the three rather extensive electrical departments which the park boards now maintain. The purchasing power for all park and boulevard lighting would also have been centralized.

GROUNDING OF SECONDARY NEUTRALS ON A. C. SYSTEMS

Meter and Distribution Committees of Empire State Gas & Electric Association Hold Joint Meeting in Rochester

A meeting of the electric meter committee of the Empire State Gas & Electric Association was held in the ballroom of the Hotel Seneca at Rochester, N. Y., on Nov. 9, the subject under discussion being "The General Operation of an Electric Meter Department." A joint meeting of the electric meter committee and the electric distribution committee of this association was held at the same place on the following day, the main subject discussed being, "The Grounding of the Neutral on Alternating-Current Secondary Distribution Systems." The underwriters' association of the State of New York was represented at this meeting. C. G. Durfee, chairman of the electric meter committee, presided at both meetings.

The morning session on Nov. 9 was given over to a general discussion of various methods of carrying on meter department work, special emphasis being given to the desirability of testing all current and potential transformers when received from the manufacturer, and then periodically checking them once every five years. It was pointed out that some companies in purchasing transformers call upon the manufacturer to furnish them with a ratio and phase-angle curve on each transformer, the manufacturers making a very small additional charge for such curves.

It was further pointed out that considerable care and judgment should be exercised in the matter of allowing trip coils and other apparatus to be connected to the instrument transformers designed for use with watt-hour meters, especially where instrument transformers of an old and more or less obsolete design are being used. The discussion brought out clearly, however, that modern instrument transformers are highly accurate and so well designed as to give little or no trouble even if connected with some apparatus other than the watt-hour meter, provided reasonable precaution is taken to prevent the transformer secondaries from overloads.

On Friday, the joint meeting was called and a lively discussion followed as to whether or not the secondary neutral on alternating-current distribution systems should be grounded.

While many of the companies are grounding the secondaries there was some little opposition to it, and the discussion brought out that most of the opposition was on account of many of the companies misinterpreting the rule in the National Code with reference to this matter, believing that it was necessary to ground the neutral to the water piping on the street side of the water meter in order to comply with the rule. The underwriters' representatives, however, made it clear that it was only necessary to properly ground the neutral at least once in every 500 ft. and that this grounding could be done either outside or inside the buildings, whereupon a great deal of the objection to it was withdrawn. The consensus of opinion seemed to be that it was desirable to ground the neutral, but it was brought out that in some localities it was extremely difficult, if not impossible, to obtain satisfactory grounds.

CO-OPERATION WITH CITY OFFICIALS AND CONTRACTORS

The Boston Edison Company Arranges a Series of Meetings to Promote Their Mutual Interests Throughout the Territory Served

An important series of co-operative meetings was begun Nov. 8 by the Edison Electric Illuminating Company of Boston, Mass., to promote the mutual interests of municipal officials, contractors and the company throughout the territory of 600 square miles. At the first meeting in the series, which will include five in all, President C. L. Edgar welcomed the leading officials of the municipalities in the territory north of Boston to an electrically cooked dinner served in the company's restaurant in the General Service Buildings, Dorchester. W. H. Lott, superintendent of right of way, presided. Mr. Edgar said that the company has no ulterior motive in asking its friends in city and town employ to become its guests, and expressed his pleasure in friendships formed at similar meetings, friendships which will prove lasting wholly apart from company relations.

William H. Atkins, general superintendent of the company, emphasized the pride the company's officials feel in the development of the communities served by the system. Figures were quoted showing the growth of company business in the northern district in the past five years, the lighting load having increased 105 per cent and the power load 132 per cent.

Everett W. Burdett, general counsel of the company and of the National Electric Light Association, closed the speaking of the evening with a stirring address on public relations, in which he set forth the ideals of the company as a regulated monopoly.

On Nov. 9 electrical contractors from the north of Boston were entertained at the General Service Buildings, L. R. Wallis, superintendent of the sales department, presiding. Mr. Atkins was the first speaker at the conclusion of the dinner. He gave reminiscences of his early career as a wireman, and pointed out that in his twenty-nine years' service with the Edison company the connected lighting load has increased from 8373 to 2,604,636 lamps. Forty-one municipalities are now on the company's lines. In the three years ended Oct. 11, the company has secured 4424 houses to be wired by contractors at a total cost of $407,156, and 3350 stores have been wired at a cost of $95,431. At present 250 houses a month are being signed up.

J. W. Cowles, superintendent of the department of installations, explained the necessity for the company's wiring regulations. No intention exists to conflict with the code or local inspection department, but uniformity in installations is desirable in the interests of economically handling so large a volume of work.

C. E. Greenwood, superintendent of the appliance department, reviewed the company's electric range campaign, which added 1019 ranges in one year to the system.

Edward S. Mansfield, chairman of the Electric Vehicle Section, N. E. L. A., then outlined the functions and sphere of usefulness of the electric vehicle, pointing out that within its own field it offers the best service which can be obtained.

L. D. Gibbs, superintendent of the advertising department, was the next speaker. Mr. Gibbs announced that during America's Electrical Week the company would give credit coupons good for 10 per cent off in the purchase of appliances before Jan. 1 next. He urged contractors to be optimists in recommending electrical appliances in establishments which are being wired. During America's Electrical Week every house taking a wiring contract will be presented with an electric toaster. E. C. Kimball of the sales department also spoke briefly. The remaining contractors' nights were scheduled for Nov. 14 and 21.

About 1500 guests will have been entertained by the company when the series of meetings closes, and the result will be increased sympathy with the company's campaign, a broader knowledge of what is being accomplished in the field of the latest electric service, and increased friendship.

SAFETY CODE ISSUED FOR EXAMINATION AND TRIAL

Bureau of Standards Acknowledges Co-operative Effort in Preparation of Second Edition and Asks for Constructive Criticism

Preliminary copies of the second edition of the National Electrical Safety Code have been issued by the Bureau of Standards. The bureau recommends that the code be adopted at present only for use on trial.

In a letter accompanying this edition Dr. S. W. Stratton, director of the bureau, says:

"This comprises, under the first three parts, a proposed national standard for safe construction and installation of electrical supply equipment in stations, of electrical transmission, distribution, and signal lines, and of the electrical utilization equipment of factories, offices, and homes. It also includes as part four a set of safety rules to be observed in work upon electrical equipment and lines.

"In the careful work of revision we acknowledge with much appreciation the great amount of co-operative effort given by our many conferees in all branches of the electrical industry. Through this co-operation the code has reached a degree of adequacy and reasonableness which it is felt can further be improved to advantage only through actual trial.

"The National Safety Code provides varying requirements according to the conditions concerned; a treatment which originated with this code and which has made it properly and reasonably applicable to all sections of the country, including both sparsely settled as well as densely populated communities. This is particularly the case with overhead wiring because of its exposure to varying weather conditions, and because it causes hazards which vary with the density of the traffic and other attendant conditions.

"The methods pursued in the preparation of the safety code and the reasonableness of its provisions have secured for it the general approval of all interests, even where initially widely conflicting as to the nature of suitable requirements for electrical construction. The code is now presented, 'for examination, trial and constructive criticism,' in the belief that it will meet a long felt need and will be useful in securing for electrical service, where its provisions are observed, the safety and ultimate economy which are such important factors in the popularity and growth of this service.

"After a trial period, modifications of some of the rules will, of course, be found desirable. A revised edition will therefore be prepared as soon as necessary. Subsequent revisions should, however, be made only at somewhat infrequent intervals in order to assure a reasonable degree of stability for electrical practice throughout the country. The advantages in this respect of a national over varying local codes are readily appreciated. The bureau desires to secure the experience of all the interests concerned with the code, and hopes through the assistance of users and administrators of the code to make it as useful as possible in promoting the safety and economy of electrical service."

INVENTORIES AND APPRAISALS

A. I. E. E. Holds Meeting to Discuss Papers Prepared by Commission Engineers

The program for the meeting of the American Institute of Electrical Engineers at the Engineeering Societies Building, New York City, on Nov. 10, which was prepared by the committee on economics of electric service consisted of a topical discussion on the subject of "Inventories and Appraisals." Three papers were presented by public service commission engineers as follows: "The Effect of Recent Decisions on the Work of Inventory and Appraisal," by Philander Betts, chief engineer, Board of Public Utility Commissioners of New Jersey; "Continuous Inventories—Their Preparation and Value," by Harry E. Carver, assistant engineer, Board of Public Utility Commissioners of New Jersey; "Growth and Depreciation," by Julian Loebenstein, junior electrical engineer, Public Service Commission for the First District of New York.

In his paper on "The Effect of Recent Decisions on the Work of Inventory and Appraisal," Dr. Betts dwelt on the conditions that have led to court decisions in the past. The general trend of recent decisions has been to make reproduction cost the sole or controlling basis of value for rate purposes. From the earliest cases down to the present time, the courts have been unanimous in the determination that the basis for rates must be the value of the "property used and useful" and have not been very definite in further defining these terms.

In conclusion he stated that property must be inventoried in such detail as will lead to a determination of its value or cost within a very small percentage of absolute accuracy. It must be classified as to its use and as to the degree of its use in the various classes of service. The inventory must include full information as to age and present condition, this information leading to accurate estimates of accrued depreciation.

Mr. Carver's paper on continuous inventories contained a list of twelve different ways in which a perpetual inventory of a company's property would be useful to any company. As to the preparation of the inventory the author was of the opinion that it seems advisable to state that a company can readily start an inventory of all new property acquired from the present time forward and all old property withdrawn from service and either replaced or abandoned, without detailing a special force of engineers to make a complete inventory of all property.

CLASSIFICATION OF PROPERTY FOR INVENTORY

There may be considerable difference of opinion as to just what method should be followed in collecting the data required, but a general scheme could be followed for either a gas, electric railway or railroad, telephone or telegraph, water or sewer utility or a private industrial plant by classifying the property into four general groups about as follows: (*a*) Land and right-of-way; building and structures; equipment of stations, buildings, etc. (*b*) Poles, transformers, meters and services for an electric company; meters, services, fire hydrants, lamps, etc., for a water or gas company, and similar items for these or other companies. (*c*) Wires, cables, conduits, crossarms, insulators, for an electric company; feeder cable, trolley wire, straight track, etc., for railways; transmission and distribution mains for water, gas and sewer companies. (*d*) Office equipment, shop equipment, stable equipment, etc.

The third paper, that by Julian Loebenstein, was a mathematical treatment of growth and depreciation. The author made the following points: First, that the per cent condition of any property is dependent not only upon the maintenance, but upon the past and present growth. Second, that under practically no condition will it be necesary to bring a property back to 100 per cent condition, but that it does not settle down to some fixed per cent condition less than 100 per cent. Third, that under certain conditions of growth, a growing company need keep no liquid depreciation reserve fund; that it may reinvest the reserve in extensions, making renewals as they come due in any given year, from the amount set aside for depreciation reserve in that year, and that by so doing the stockholders' capital is kept intact, yet the depreciated value of the whole property is the fair one, both for consumer and stockholder, for rate-making purposes. Fourth, that for a company which has stopped growing or for one which is growing at a rate not large enough to use all of the depreciation reserve for reinvestment in extensions, it will be necessary to have a continually varying amount in a liquid depreciation reserve fund, and that this amount will fluctuate in a manner depending upon the company's growth. Fifth, that since such a liquid reserve may be necessary for a growing company, and will be necessary for a company which has ceased to grow, the same return should be allowed on such a reserve as on any other capital invested in the property, and that such return should be available for dividends, provided that the cost new, less depreciation, is to be used as a basis for making the rates.

Discussion

In the discussion which followed W. B. Jackson stated that for many years he had been of the opinion that a detailed inventory and cost record of the property of a public service company is highly valuable to the company, especially in giving those in charge a visualization of the property as it stands both from the purely physical point of view and as to the spread of the cost over the property; also in giving opportunity to record in and out charges in cases of changes and improvements. He believed that careful record of changes should be kept of all property for statistical purposes, but he did not believe that so-called depreciated value should be carried along as a part of the inventory and cost record because it is likely to become seriously complexing inasmuch as the estimated useful lives of the different parts of the property change as the months pass by.

George W. Whitemore presented a written discussion in which emphasis was laid on the definition of depreciation.

D. B. Rushmore stated that he believed that gold depreciation should be considered in depreciation of value of property.

E. J. Cheney pointed out that reproduction-new theory now stands because accurate records of actual investment costs are probably not available in many cases. Later when records are available the money actually put into the property by investors will be a proper record for all cases.

Prof. W. S. Franklin said that the cost of reconstruction or reproduction takes gold depreciation into account. Another variable, however, comes in also, namely, that arising from improved methods or machinery, which may tend to lessen value of property, whereas gold depreciation alone would tend to increase values.

Philander Betts in closing, emphasized the value of keeping a continual inventory and appraisal of property.

There must be some reserve plant to accommodate new customers and take care of breakdowns, but due consideration must be had for the property that has too much reserve owing to mistaken engineering judgment. A company before it obtains a profitable number of customers is in an undeveloped stage. The company must build itself to a point to fit its plant before it can say that rates must furnish a return on all the investment.

Power of Co-Operation Among Manufacturers

Broad Purposes of the Associated Manufacturers of Electrical Supplies and the Valuable Intensive Sectional Work Are Discussed by President Robert K. Sheppard

Co-operation is the modern way of securing efficiency through the co-ordination of different branches of an industry. In this interview Robert K. Sheppard, sales manager of the Simplex Wire & Cable Company, tells of the foundation-idea underlying the Associated Manufacturers of Electrical Supplies, of which he is the president. Intensive co-operative work is obtained through fourteen well-organized sections serving different branches of the industry. Young as the association is in years of existence, the results which it has achieved are phenomenal.

TWELFTH IN A SERIES OF "TALKS IN THE INDUSTRY"

BY FREDERIC NICHOLAS

"THE impulse to form the organization known as the Associated Manufacturers of Electrical Supplies," said Mr. Sheppard, "came to the manufacturers after the discovery by many simultaneously that an emergency could confront them suddenly and might be followed by serious consequences if they lacked machinery with which to bring their members together for collective action.

"The products of the several hundred manufacturers who can use such an association are numerous and varied. The group interested in any one class of products is small compared with the membership as a whole. Self-interest is the reason for each member's co-operation. Those being the existing conditions, the method which was adopted of developing the association's activities by sections of the industry promised the most satisfactory results. That conclusion has been justified by the urgent demand for the organization of additional sections, the rapidity with which such sections have grown in membership, and the speed with which new activities have been undertaken. That the sectional work already covers a large field in the electrical industry is shown by the wide range of the organized activities of the fourteen different sections. The present scope of the movement is illustrated by the accompanying diagram.

SMALL AND LARGE CO-OPERATE

"As the character of the sectional work has become known to the manufacturers in different branches of the industry the membership has grown steadily and healthily. The small and the large manufacturer co-operate together with equal voice in all decisions. More than 275 representatives of member companies are now working together in the common cause. This large total has been enlisted in the work of the association in an incredibly short period. The association was conceived early in 1915, but its real development was not started until several months later. The need for new sections is impressed so insistently upon the general secretary of the association, Charles E. Dustin, that his office is continually organizing and starting them in their useful co-operative work.

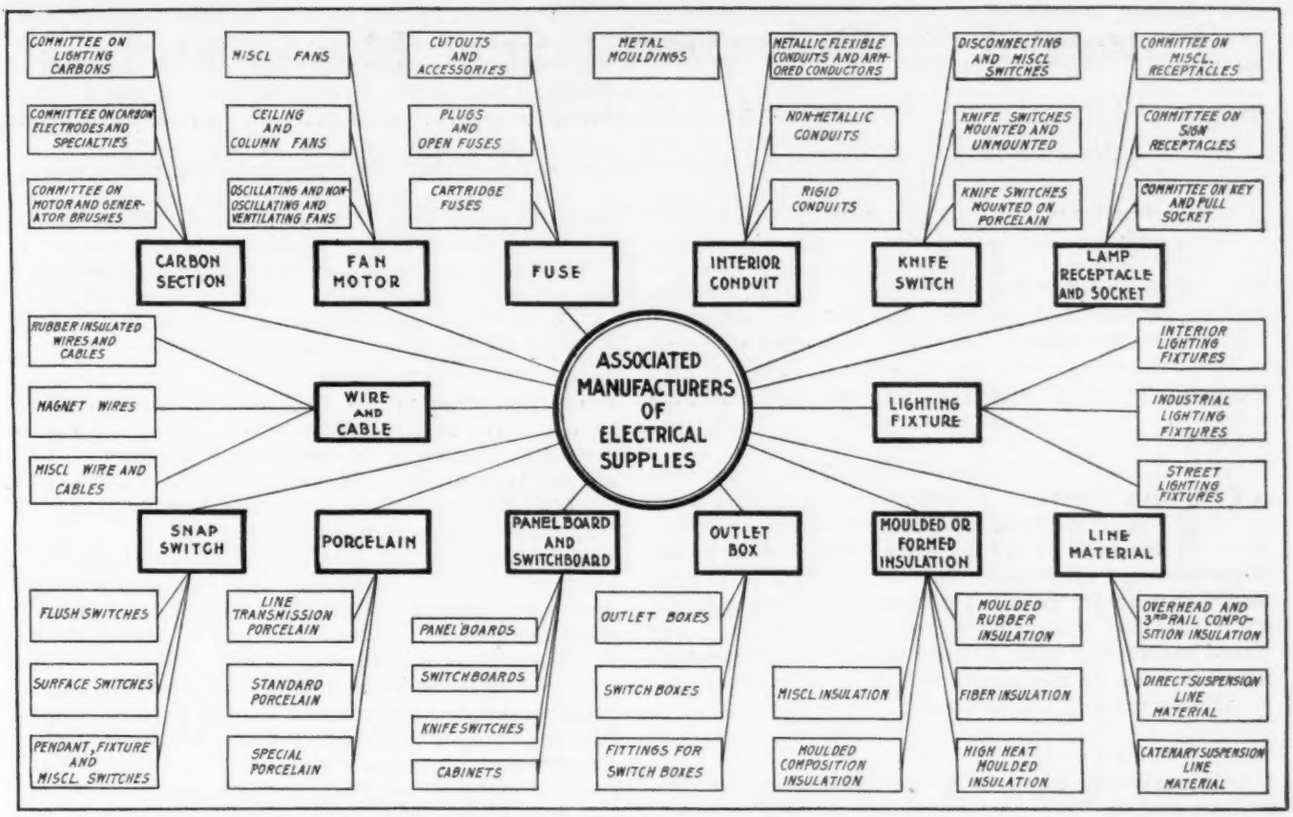
"To safeguard the entire membership against inexpedient or unwise zeal, which active work in the sections may bring forth, is one of the important duties of the legal department of the association, which is under the direction of Thomas M. Debevoise. By a very sensible provision in the constitution of the association the board of governors must approve each sectional activity or decision before it is finally adopted. Thus, the sober judgment of enlightened and not directly interested persons is obtained after ample consideration by counsel and before any portion of the association commits itself or the association as a whole to any principle or practice. Still the initiative of the section members is not discouraged and their lawful co-operation is not impeded. They may enlarge and intensify all appropriate section work as in their judgment may seem desirable.

"The objects of the association, as set forth in the constitution, are 'to advance and protect the interest of the manufacturers of electrical supplies and of the manufacturers of materials entering into electrical construction, in manufacturing, engineering, safety and other problems, to promote the standardization of electrical materials, to collect and disseminate information and to promote co-operation among the members.' Broadly as this covers its natural functions, the association recognizes the reasonable limitations of its field, and does not encroach upon the realms belonging to other associations in the industry. It highly appreciates the work which they are doing and cherishes sympathetic interest in their activities.

A FIELD FOR EACH ASSOCIATION

"The Electrical Manufacturers' Club, the Electric Power Club, the National Electric Light Association, the American Institute of Electrical Engineers, the American Electric Railway Association, the Electrical Supply Jobbers' Association, the National Electrical Contractors' Association, and many other organizations are rendering inestimable service to the industry at large, to their companion associations and to their own members. The niche which each fills efficiently is all its own. When interests overlap the Associated Manufacturers of Electrical Supplies will heartily join hands; when it is certain that a common interest can be better guarded and developed by another organization we are ready to surrender our share therein; when its proper activities are not involved the association will keep hands off and will applaud the achievements of others; within its own boundaries the Associated Manufacturers of Electrical Supplies will conserve independently the interests committed to it. Already, through participation in the Electrical Manufacturers' Council, it has grasped the opportunity to join hands when interests overlap; it is to be hoped that ultimately a general clearing house for the entire electrical industry may be organized successfully.

"Frequently other organizations desire the standardization of products made by members of the Associated Manufacturers of Electrical Supplies, and appoint special committees to meet like committees from our association. To all such committees the association offers its hearty co-operation. Through the appropriate section the different interests may counsel together to promote the standardization of articles which will satisfy all and which can be made with existing factory equipments at reasonable cost. Too often the laudable efforts of engineers to standardize manufactured products have been abortive because their standards, while



The products of the several hundred manufacturers who can use such an association as the Associated Manufacturers of Electrical Supplies are numerous and varied. As indicated above, fourteen different sections have been formed and these are subdivided for more effective work into committees having specific subjects for consideration.

theoretically desirable, were too difficult to make, or were excessive in cost. The past has witnessed much waste of human energy because the task of standardization has been approached from only a few of its many angles.

Indorses Cost Determining

"The association heartily indorses the campaign of the Federal Trade Commission for the universal use by manufacturers of accounting systems and methods of determining costs suitable for each special line of industry. The Electrical Manufacturers' Council, which is composed of four members each from the Electrical Manufacturers' Club, the Electric Power Club and the Associated Manufacturers of Electrical Supplies, is working actively upon the same problem. Through the able committee already appointed by this council, the three associations will secure practicable accounting and cost determining systems for their members. Those systems will give to each manufacturer the framework which he can enlarge and clothe with the details requisite for his own business. All sections of the association have special committees at work and ready to utilize the results achieved.

"When the sections have worked out systems applicable to their special wants the association will present them before the Federal Trade Commission. And, to quote from the address of Edward N. Hurley, chairman of the commission, presented before the Ohio Bankers' Association at Columbus, Ohio, on Sept. 13, 1916, 'the commission will counsel with them and will approve it as a basic system for that industry. With this general standard officially approved, details to vary, of course, with the individual companies, the association has a strong argument to bring its members into line with sound accounting.'

"In our work we find that affiliations between associations operating in different but contributing fields are desirable. Membership in the Chamber of Commerce of the United States of America, for example, benefits the Associated Manufacturers of Electrical Supplies by keeping it intimately acquainted with all governmental activities in Washington, and with the opinions expressed throughout the entire country on questions of vital interest to industry as a whole. Also, it gives to this organization a satisfactory channel through which to add its influence in favor of thorough and fair legislative and executive investigations, acts and decisions by the different departments and commissions in the federal government.

"Membership in the National Fire Protection Association is useful because many members of our association are directly concerned in the fire protection requirements of that association and in the installation rules promulgated by the electrical committee of that association.

Contact with Underwriters' Laboratories

"The association and its sections have intimate contact with the Underwriters' Laboratories through direct representation in appropriate industry conferences established by the Underwriters' Laboratories for that purpose. In those conferences the technical problems common to the Underwriters' Laboratories and the manufacturers are considered and settled harmoniously. Non-participants and the general public can scarcely comprehend how earnestly and sincerely those conferees labor to establish reasonable requirements which will uphold only standard products. The fruit of their work is increased safety for life and property.

"In similar ways and for mutually helpful purposes the Associated Manufacturers of Electrical Supplies welcomes friendly relations with other organizations.

"The compilation of statistics is a natural function of such a trade organization as ours. The association is so young that comparatively little of that large work

has yet been accomplished. It is a further beneficial development which the future has in store for the manufacturers of electrical supplies.

Dynamic Force of United Action

"Underlying the entire work of the association and explaining its broad purpose is the conception that voluntary united action by men having common interests is a dynamic force. In the past such force has been systematically invoked in America by only a small percentage of the population. That percentage includes few who are not associated in labor unions. Business enterprises generally have battled alone and achieved alone. People in other lands, guided in co-operative measures by autocratic authorities and drilled to obedience, have attained remarkable manufacturing and merchandising efficiency. Waste of effort and substance has been minimized.

"It is not so in this land where men have worshipped individualism. Ingenuity and inventive genius have aided the American manufacturers tremendously and will continue to do so in the future. But now the power of co-operation is needed. The welfare of business enterprises, whether small, of moderate size or large, will be jeopardized again and again unless industries are joined together in organizations through which common interests may be considered and a united demand expressed with force and decision."

PROGRESS OF A. E. W. PLANS

Wide Scope of the Celebration Is Indicated by Reports from Different Sections of the Country

While the success of Electrical Prosperity Week last year was far greater than anticipated, progress reports from the local committees in the different sections of the country indicate that this year's celebration, which is but two weeks away, will far surpass in success that of last year. A late report shows that the Federation of Women's Clubs, particularly in the West, is joining in the movement.

Electric shows, pageants, prizes for essays written by school children on the use of electricity, and a generous use of advertising and educational publicity material mark this year's local celebration. Concerted efforts, which for the most part have been highly successful, have been made this year to interest local non-electrical organizations to participate actively in promoting the week.

More of the metropolitan centers this year have become interested in the movement. In fact, practically every city in the Union of any size has planned some sort of celebration for the week.

Reports of activities from some of the larger cities not heretofore published follow:

A very comprehensive campaign has been mapped out by the St. Louis committee. Contests will be run by the leading newspapers for the best essays by school children on the topic, "Electricity in Every-day Life." Twenty prizes will be offered, the more important of which will be an electric washing machine, an electric vacuum cleaner and a sewing machine motor. The prizes will be shown in the windows of the local electrical dealers and contractors up to the time they are awarded. Plans are on foot to have contractors and dealers take a combination page of advertising in all of the daily papers during America's Electrical Week. Other plans include a generous use of street car and billboard advertising, electrical moving picture films, pennant display, a jubilee and dance for which $250 has been appropriated and a band and electrical floats.

The controlling idea back of the celebration of America's Electrical Week at Chicago is one of directing the public's buying impulse. All of the work undertaken has as its object creating a demand for the sort of electrical goods that can be had. The present market conditions make it unwise, it is thought, to spend a great deal of money exploiting electrical goods in general, when the demand already exceeds the supply in so many lines. The expenditure for the celebration will, therefore, be a moderate sum.

The local committee, of which John F. Gilchrist of the Commonwealth Edison Company is chairman, has announced that 300,000 mailing folders will be distributed by the utility companies and other electrical firms. The Aladdin poster in colors and a secondary slide inviting people to visit electrical stores, will be shown in 700 motion-picture shows. Speakers will address the Chamber of Commerce and the Electric Club-Jovian League on electrical subjects. Other educational addresses will be delivered before civic and industrial clubs, high schools and settlements.

A co-operative campaign to stimulate housewiring business is being arranged. In addition the Commonwealth Edison Company will offer cash and electrical merchandise prizes for essays by school children on "Electricity in Every-day Life."

Special effort is being made by the Minneapolis committee to have window displays in all parts of the city during the week. All drug stores, hardware dealers, department stores and retailers handling electrical goods of any kind are being urged to join the campaign and suggestions are being offered covering suitable displays, animated displays especially. The committee is urging the exclusively electrical concerns to contract for a liberal amount of newspaper advertising beginning around the middle of this month. The Jovians have planned an entertainment for the week, the final details of which will be announced later. On account of the uncertainty of the weather no plans have been laid for any outdoor demonstrations, nor will it be possible to put on an electrical show. C. D. Wilkinson writes:

"We are trying to make this a strictly business campaign rather than one of amusement, and we hope to place in the hands of every family using electricity a sufficient number of circulars descriptive of various electrical devices to create in the minds of all of these people the desire to own something electrical."

J. M. Hannaford, Jr., of the Northwestern Equipment Company, announces that all local dealers will use electrical windows during the week, Dec. 2 to 9, and that electrical pages will be run in all of the newspapers in St. Paul.

The exhibit of the best 125 posters received among the 781 submitted in the national poster competition managed by The Society for Electrical Development, attracted widespread interest in Pittsburgh last week. The Jovian League, the American Institute of Electrical Engineers and the iron and steel engineers had special nights to attend the display in the Carnegie Institute. The Pittsburgh Advertising Club and poster interests advertised the exhibit. This poster display did much to center the celebration of the week in Pittsburgh upon an electrical show to be held either in the William Penn or Fort Pitt Hotels. Admission to the show will be by invitation.

Joseph F. Becker, commercial manager of the United Electric Light & Power Company, New York City, announces that the week will be celebrated throughout the territory covered by the United company. Special sales drives on home appliances, illuminations of business buildings in upper New York and window displays by electrical dealers will be features of the week.

Construction and Layout of High-Tension Equipment

An Analysis of Improvements in Indoor-Station Apparatus and Construction Methods from the Standpoints of Installation and Operation with Typical Examples of Equipment

BY M. M. SAMUELS

PROBABLY the most remarkable progress in electrical construction is typified by the evolution from the first transformer to present-day standardized apparatus rated as high as 140,000 volts, this great stride taking place in the short period of only thirty years. The progress has been so rapid that a handbook or text-book on high-tension construction becomes out of date during the process of printing and engineers have to keep their eyes wide open to avoid overlooking new types of apparatus and improvements in construction methods. It is the object of this article to review the present status of high-tension developments, and to indicate a few places where improvements are required and feasible from installation and operating standpoints. No attempt is made to list or illustrate all types of apparatus and methods of construction, and only typical features which are of special interest to plant designing engineers will be considered.

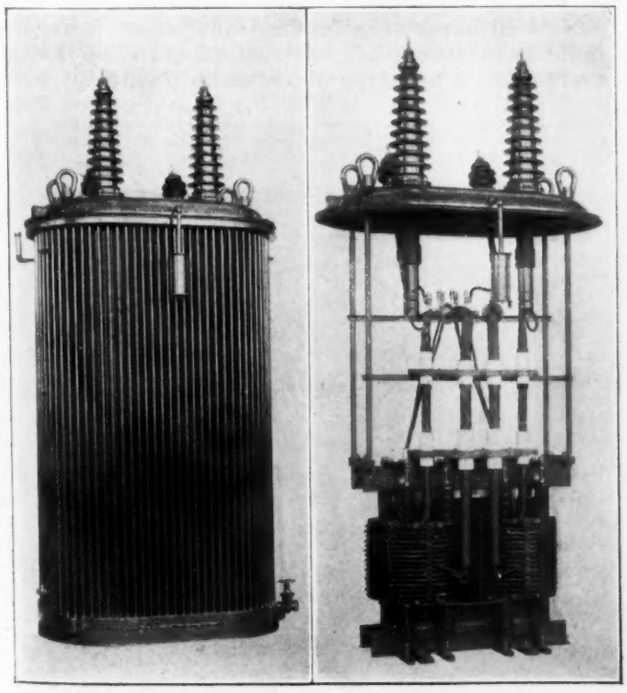
TRANSFORMER DEVELOPMENTS

Transformers are now being built for very high voltages and ratings for both single and three-phase circuits. To give an approximate idea of the enormous size of modern transformers for an average installation it may be pointed out that the 10,000-kw. three-phase, 6600-66,000/110,000-volt units which have been installed by the Tennessee Power Company in its various power houses on the Ocoee River, occupy floor space of approximately 20 ft. by 8 ft., are about 19 ft. high and weigh approximately 200,000 lb. Since, as is evident, such apparatus could not be shipped assembled, the tanks had to be riveted together in the field. This, of course, requires special care, since the facilities of a modern transformer factory are not available in construction camps, the latter being generally located at a considerable distance from any industrial center.

Indoor-type transformer tanks are built mostly of corrugated steel and are mounted on cast-iron bases. Steel bases are being used more extensively than they formerly were, however, on account of the fact that modern welding methods permit attaching them to tanks very easily. Since indoor transformers of large rating are always water cooled no special radiators are required, the tank surface in addition to convection currents in the water being sufficient to carry away the heat generated.

In hydroelectric power houses where a great quantity of water is available at little cost, the cooling water is usually taken from the intake, circulated through the transformers under the force of gravity and discharged into the tail race, so that no elaborate water piping is required At substations, however, where city water often has to be used, or where the water has to be pumped at great expense, a saving can usually be realized by installing cooling facilities and recirculating the water through the transformer.

Cooling towers have been used to great advantage for this purpose, but recently cooling ponds with spray nozzles are being preferred by most engineers. In steam stations, it is sometimes an advantage to pass the transformer water through the water



FIGS. 1 AND 2—ASSEMBLED AND UNASSEMBLED VIEWS OF 600-KVA. 66,000/2300-VOLT SINGLE-PHASE TRANSFORMER

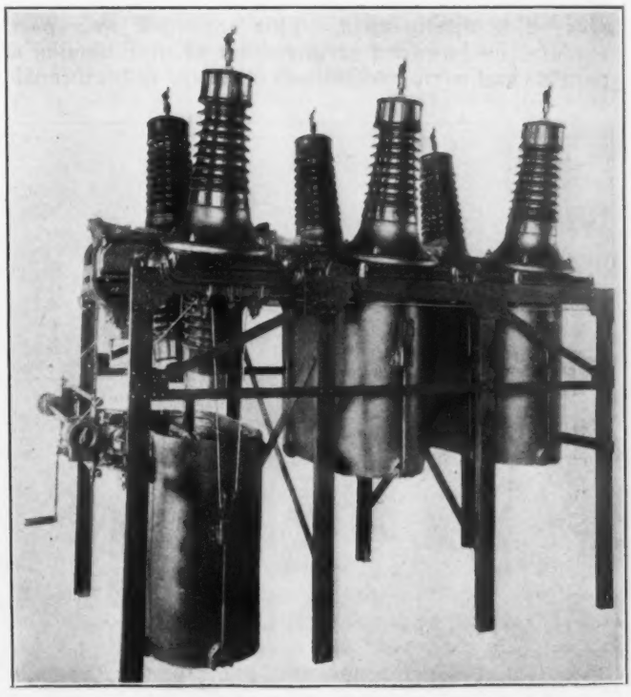


FIG. 3—ANGLE-IRON FRAME MOUNTING FOR 70,000-VOLT CIRCUIT BREAKER

heaters, thus utilizing part of the energy lost through radiation from the transformers. The arrangement of piping and space required for this as well as the oil filtering and pumping equipment should be given special consideration when making a preliminary power station or substation layout since the crowding of piping will often cause complications in the high-tension wiring, which should by all means be avoided.

In connection with the subject of transformer layout there is one obstacle which station designers encounter for which no remedy can be offered at the present time; i. e., the great variation in the shape of different makes of transformers. While it is always possible to estimate the floor space required by a rotary, motor generator or an oil switch, it is impossible to do so with transformers. Single and three-phase transformers are made by different manufacturers in different shapes, some being round, others oval and still others square. On this account before knowing which form of transformer is to be used it is impossible to make an approximate preliminary layout of a station. Usually crowding in one direction and wasting space in the other direction will result when another type than the one originally considered is finally used. This condition may partly explain the awkward arrangement of high-tension apparatus and wiring sometimes observed in high-tension stations, since it is not always possible to determine upon the type of transformer before starting the building foundations.

Reverting to transformer construction, it may be pointed out that bushing troubles have been practically eliminated and tank construction so improved that leakage now occurs only very rarely. High-voltage testing transformers are available at the present time in all test rooms, the highest test pressure used for practical purposes being about 750,000 volts. By installing the transformer and high-tension switching in inclosures and interlocking the compartment door with the low-tension oil switch of the transformer, the operation of these high-tension test sets has been made practically hazardless. The exterior and interior of a modern 66,000-volt transformer are shown in Figs. 1 and 2.

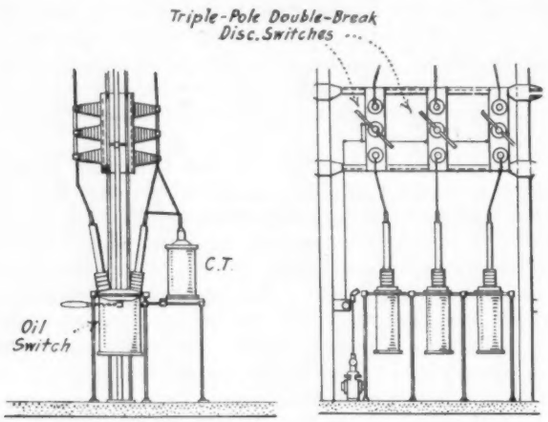


FIG. 4—TRIPLE-POLE DOUBLE-BREAK DISCONNECTING SWITCH AND OIL SWITCH MOUNTED ON PIPE SUPPORTS

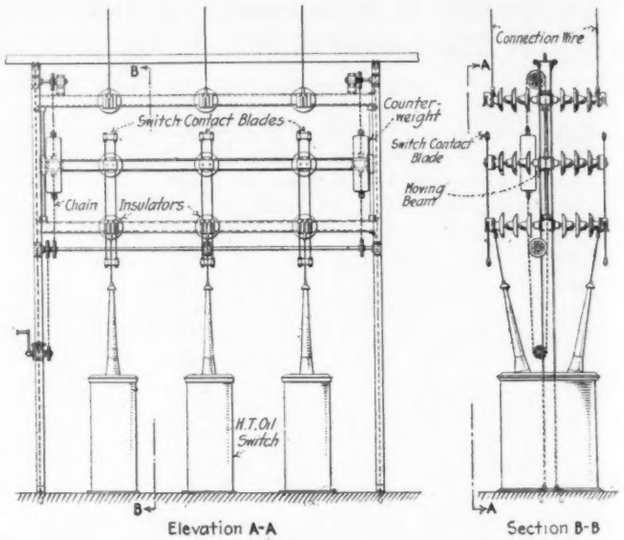
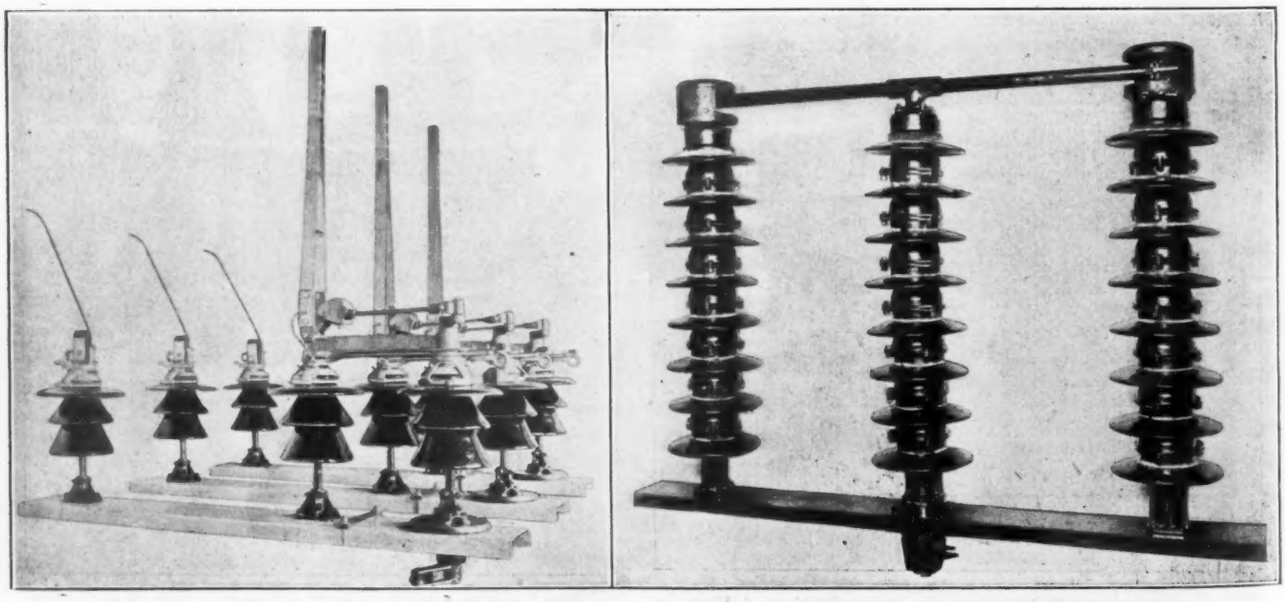


FIG. 5—BAYONET-TYPE DISCONNECTING SWITCH REQUIRING SMALL AISLE SPACE

MOUNTING OF OIL SWITCHES

Next in importance to the transformer as regards rapid development of construction is the oil switch, there being a new type of switch in practically every



FIGS. 6 AND 7—SINGLE-BREAK 70,000-VOLT AND DOUBLE-BREAK 110,000-VOLT DISCONNECTING SWITCHES FOR ROOF INSTALLATION AND REMOTE OPERATION

new station that is constructed. Low-tension oil switches differ so much that different bus structures have to be used with nearly every type. On the other hand, all modern high-tension oil switches have approximately the same outside appearance, and there

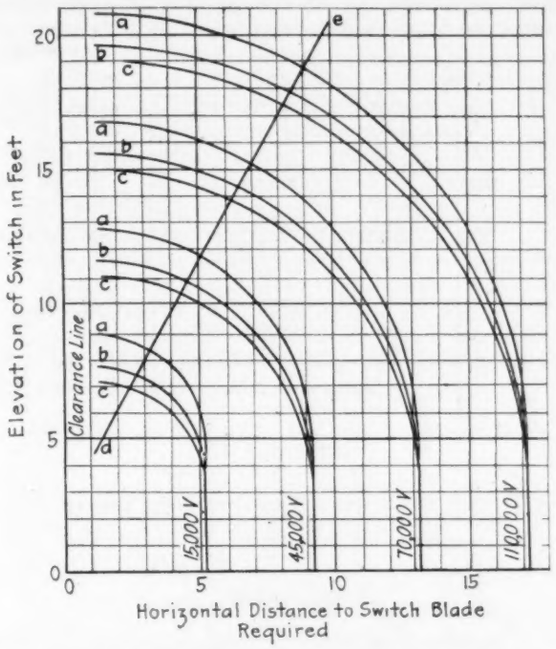


FIG. 8—SPACE REQUIRED FOR OPERATING DISCONNECTING SWITCHES AT VARIOUS ELEVATIONS

In plotting the curves it was assumed that the operators are of average height, curves a, b and c representing requirements with high, medium and low-reach switch sticks. Line de indicates the maximum inclination of the switch stick from vertical when closing a switch. It may be assumed that operators can stand 30 deg. to either side of a 300-amp. switch.

is very little difference in the required floor space. Older types of high-tension oil switches required concrete or steel foundations in order to raise the terminals above reach. Most recent oil switches, however, are arranged for pipe or angle-iron mounting, which not only does away with the necessity of a foundation, but permits the tank being lowered easily for repairs or examination. For automatic operation of the older types of high-tension oil switches, series relays were mounted on high-tension insulators and connected with small auxiliary tripping switches by means of long wooden rods. This rather clumsy and primitive construction is now very seldom used, however, its place having been taken by current transformers. Where the line current has to be measured, as is required in most cases, the meter current transformers are utilized for operating the relays. When metering is not required, bushing-type transformers

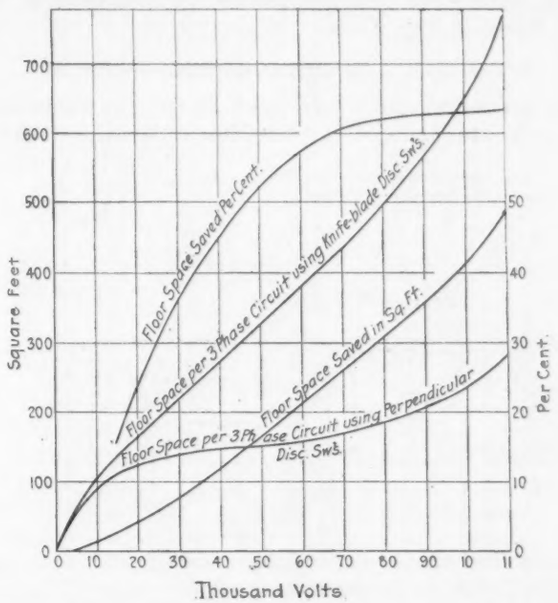
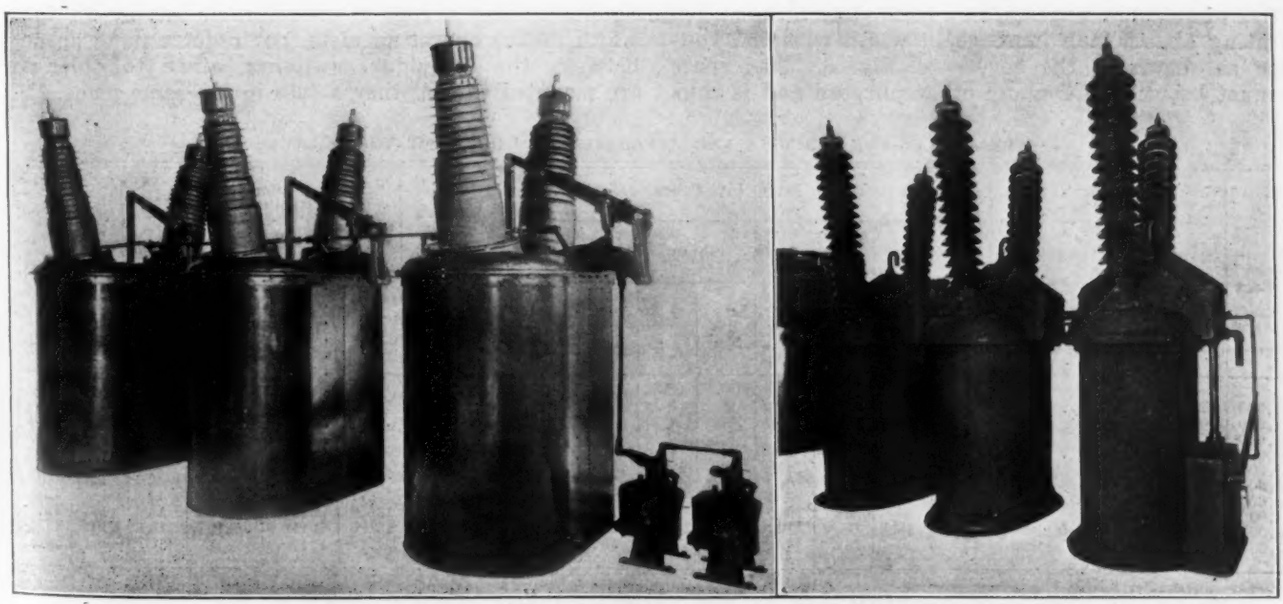

Square Feet
Per Cent.
Thousand Volts
Floor Space Saved Per Cent.
Floor Space per 3 Phase Circuit using Knife-blade Disc Sw's.
Floor Space Saved in Sq. Ft.
Floor Space per 3 Ph. Circuit using Perpendicular Disc. Sw's.

FIG. 9—SWITCHING FLOOR SPACE REQUIRED PER THREE-PHASE CIRCUIT WITH SWITCH SHOWN IN FIG. 5

In plotting these curves it was assumed that knife-blade perpendicular disconnecting switches are used on both sides of each oil switch. The floor space given includes that for switches and aisles.

mounted on the oil-switch terminals are generally employed for operating the relays.

Since a continuous wall or steel member is seldom installed along a line of oil switches on which to support a control bus individual circuits usually have to be carried directly from the switchboard to each oil switch. A method of supporting high-tension oil switches so their terminals will be above reach, which does not require elevated foundations, is shown in Fig. 3. This switch, which is a 70,000-volt General



FIGS. 10 AND 11—SOLENOID-OPERATED 150,000-VOLT AND 130,000- VOLT OIL SWITCHES

Electric K-O-26 oil switch, is mounted on an angle-iron framework and is equipped with a manually operable mechanism for lowering the oil tanks. In using this, hangers carrying pulleys are attached to the frame as shown herewith, the hoisting cable laid in the pulley grooves and looped under the pulleys on each end of the tank, and the tank detached from the frame and lowered. Pipe supports are also employed for mounting oil switches similar in arrangement to that shown in Fig. 4.

IMPROVEMENTS IN DISCONNECTING SWITCHES

Except in extreme cases, such as for bus selection, disconnecting switches are auxiliaries to oil switches, serving only to isolate the switch when inspection or repairs are necessary. On this account, they may be considered a necessary evil and should not be permitted to have too much influence upon the character and quality of a high-tension layout. All of the old-type disconnecting switches with the exception of the pneumatically operated units were usually opened and closed by means of a switch hook attached to a hickory stick of suitable length. This method requires an operating aisle which increase in width with the voltage as shown in the curves of Fig. 8. The space cannot be utilized for any other purpose and is thus wasted. Especially in hydroelectric stations with elaborate substructures, this has called for an enormous expense and has led to the development of many types of disconnecting switches which are operated from the floor by means of a pipe mechanism. Most of these switches are of the pivot type, the center insulator turning around its pin as an axis and connecting only to the top contacts.

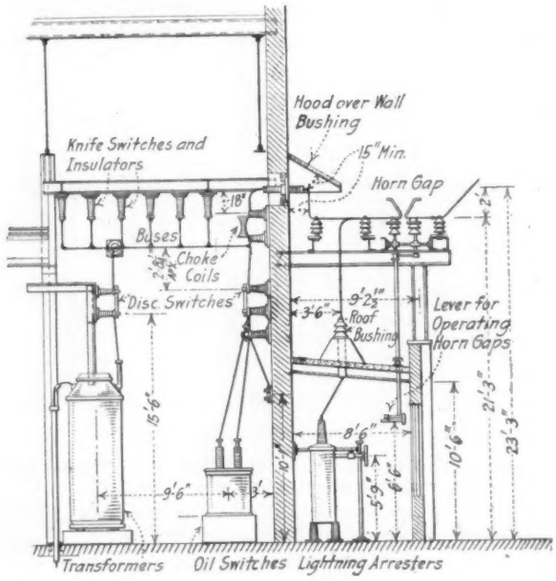


FIG. 12—CONDITIONS UNDER WHICH BOTH WALL AND ROOF BUSHINGS WERE REQUIRED

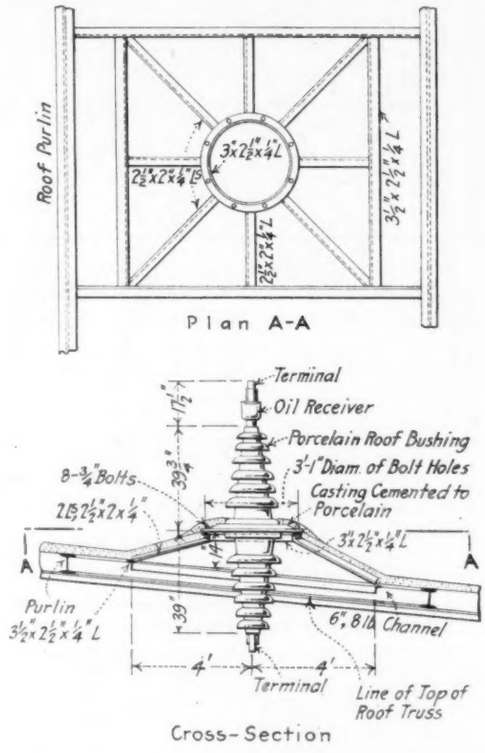


FIG. 13—SUITABLE METHOD OF MOUNTING 120,000-VOLT ROOF BUSHING

tacts being made at the top as well as at the bottom. Such switches were installed by the J. G. White Engineering Corporation in the Frackville substation of the Eastern Pennsylvania Railways Company. They are rated at 30,000 volts and were made by the Electrical Engineers Equipment Company. Six disconnecting switches, three on each side of each oil switch, are operated by one common lever, as shown in Fig. 4. Such switches permit a considerable saving in the width of the operating aisle, but require more space between the individual switches, since the blades are mounted so that they rotate in the same plane.

CLEARANCES FOR CIRCUITS AND APPARATUS AT DIFFERENT VOLTAGES*

Maximum Voltage	Spacing of Live Parts, In.				Spacing of Buses, In.				Live Parts to Ground, In.				Min. Spacing of Horn Gaps, In.	Minimum Height of Line Over Horn Gap, In.	Floor Space Required for 3-Phase Lightning Arrester, Ft.	Floor Space Required for 3-Phase Oil Switch, In.		Length of Stick for Operating Knife Blade Disc Switches, Ft.	Minimum Elevation of Knife Blade Sw's, Ft.	Minimum Width of Operating Aisle for Knife Blade Sw's, Ft.
	Indoor		Outdoor		Indoor		Outdoor		Indoor		Outdoor									
	Minimum	Recommended	Minimum	Recommended	Minimum	Recommended	Minimum	Recommended	Minimum	Recommended	Minimum	Recommended				Indoor	Outdoor			
2,300	2½	4	6	8	6	8	8	12	2	3	4	6	....	....	.....	.....	.....	....	....	....
7,500	4	4½	12	15	9	10	15	18	3	4	5	7	....	....	.....	.....	.....	....	....	....
15,000	5	6½	18	21	10	12	20	24	3½	5	6	8	48	60	5x 9	.....	.....	4	7	5½
22,000	7½	9	27	30	12	15	36	39	6	7½	8	10	52	72	5x 9	26x 82	.....	5	8	6½
35,000	12	15	33	36	18	22	38	41	10	12	11	14	60	84	5x11	34x 86	.....	6	10	8
45,000	16	19	42	46	24	27	50	54	14	16	14	17	74	96	9x14	40x100	40x124	8	11	9½
70,000	24	30	60	66	36	42	72	78	21	24	23	26	98	120	11x17	48x124	48x142	12	15	13½
90,000	32	38	72	80	48	54	88	96	27	32	29	34	120	132	13x22	60x142	60x146	14	17	15
110,000	38	48	80	90	60	66	100	110	33	38	40	45	120	144	13x25	70x180	70x184	16	19	17½
140,000	50	60	100	120	72	84	132	144	42	50	45	54	140	180	.....	.....	.....	....	....	....

*Clearances refer to bare conductors. Areas do not include passageways. Areas for lightning arresters and oil switches are for estimating purposes. There are switches on the market requiring less space. Areas for lightning arresters include horn gaps over tanks and are for fused arresters. For non-fuse arresters considerably less space is required. Spaces not filled out represent apparatus on which the different manufacturers vary too much to permit obtaining an average or maximum.

In the writer's opinion the best type of disconnecting switch which has been developed so far is shown in Fig. 5. This switch was designed by The J. G. White Engineering Corporation and is now employed at the Parr Shoals plant in South Carolina and Stevens Creek plant at Augusta, Ga., in both power houses and substations. Considering the enormous amount of floor space saved by its use as shown in the curves Fig. 9, it is hoped that the idea will be further developed and utilized by switch manufacturers. In this case also, six disconnecting switches are operated simultaneously, thus saving a great deal of time which may be of great importance when it is necessary to quickly examine an oil switch. While a chain mechanism is employed for operating the switches it should not be difficult to design a bell-crank arrangement if this should prove to be of any advantage. Other types of disconnecting switches are shown in Figs. 6 and 7. These units are really air-break switches, however, and are generally placed in the outgoing lines on the roof with the operating mechanism inside.

METHODS OF CONNECTING INSIDE AND OUTSIDE EQUIPMENT

The problem of bringing a high-tension wire out of a building is similar to bringing one out of a transformer. For the same reason that most transformer high-tension leads are brought out through the top it will be found best to bring high-tension conductors out of power houses or substations through the roof. In some cases, however, it will be found better to use wall outlets. No fixed rule can be made in this respect, since the method depends on the particular layout, arrangement of buses, disconnecting switches and lightning arresters, being the ruling factors. For pressures of 100,000 volts and higher, the weight of the outlet bushing and its great size as well as the required ground clearance from steel must be taken into consideration when designing the roof. A good example of a 120,000-volt roof outlet cone is shown in Fig. 13. The base casting of the porcelain bushing is bolted to a circularly-bent angle iron which is attached to the roof purlins by radial angle irons. This construction was used in the Ocoee power house of the Tennessee Power Company. In Fig. 15 is shown the type of roof outlet used in the Stevens Creek power house, and also a roof installation of horn gaps with the operating rod running through the roof slab. It may be pointed out that the roof beams are spaced with due regard to electrical conditions. Both roof and wall outlets are shown in Fig. 12 with the horn gaps mounted on special steel work over the lightning-arrester leanto. This arrangement is used in the 35,000-volt part of the Rock River power house of the Tri-City Railway & Light Company, Davenport, Iowa, and shows what careful planning can accomplish under the most unfavorable conditions in an old building. Different types of wall outlets are shown in Figs. 14 and 16. The former is a 35,000-volt gashouse substation connected with the Tri-City Company and the second is a 60,000-volt arrangement at the Parr Shoals power house. The method of setting wall bushings must depend on the particular conditions, and due consideration must be given to architectural features.

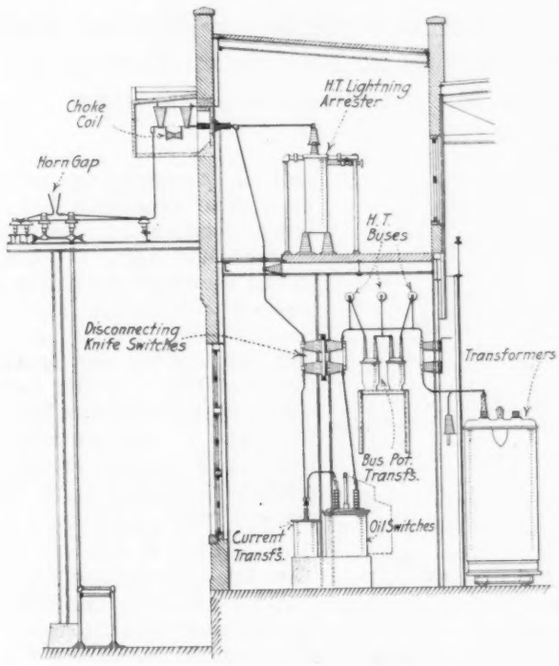


FIG. 14—METHOD OF EXTENDING 35,000-VOLT CONDUCTOR THROUGH WALL

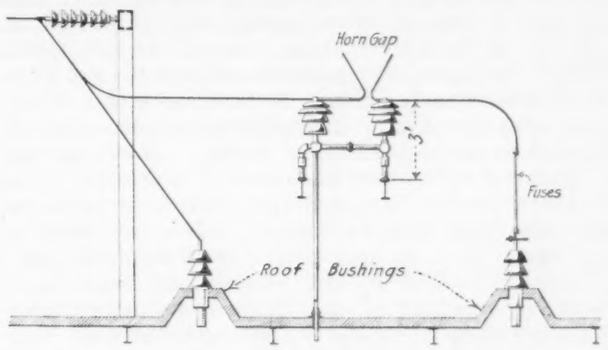


FIG. 15—ROOF INSTALLATION OF HORN GAPS OPERATED FROM WITHIN STATION AND CONNECTED THEREWITH THROUGH ROOF BUSHINGS

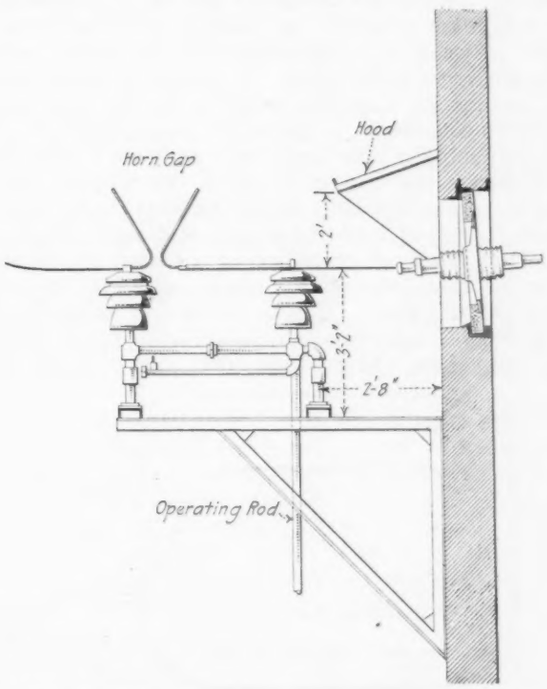


FIG. 16—WALL-TYPE BUSHING FOR 60,000-VOLT INSTALLATION

No rules or classifications are possible with reference to high-tension wiring. However, given certain types of apparatus and a wiring scheme it will generally be easier for a designer to devise a good arrangement with high-tension equipment than it will be to work a

low-tension bus structure into rather crowded space.

While loose wiring or strain-insulator units may be suitable on transmission-line towers they are out of place in any station. Only rigid conductors, well supported and properly spaced, should be considered for high-tension station layouts. For this purpose copper pipe or brass pipe is preferable to wire. A table, compiled by the writer, and giving all the necessary data for pipe conductor installations was published on page 866 of the April 15, 1916, issue of the ELECTRICAL WORLD. Minimum and preferable clearances are given in the accompanying table. In this connection it may be pointed out that all energized parts should be out of reach to prevent accidental contact. The buses may be arranged either in a horizontal or a vertical plane, it being safe to disregard the arguments advanced that something may accidentally fall across horizontally arranged buses and short-circuit them, and that an operator holding a length of pipe may short-circuit vertically arranged buses. There is no more chance of a piece of metal falling across horizontal buses than there is of a piece of pipe short-circuiting vertical buses. Choke coils should be located as near the building entrance as practicable and if possible even outdoors, as shown in Fig. 15.

Lighting of high-tension rooms is a difficult problem. Uniform illumination is out of the question, since the lighting units must be placed in accessible positions and therefore must generally be very low. Furthermore, it is difficult to illuminate disconnecting switches and buses located at high elevations. Floodlighting may be suggested as a possible solution of the problem of properly lighting high-tension rooms. Otherwise it is necessary to resort to special reflectors and frosted lamps. Guards should in most cases be provided for incandescent lamps to protect the filaments from static effects.

The arrangements shown in Figs. 4, 5, 12, 13, 14, 15 and 16 represent typical construction employed by the J. G. White Engineering Corporation in various plants. In a later article will be discussed the construction and arrangement of high-tension equipment installed out-of-doors. Outdoor transformers and lightning arresters will be among the subjects dealt with.

Theory and Operation of Split-Phase Magnet—I

Derivation of Vector Diagram of Split-Phase Magnet Action, Considering Flux and Exciting Current, Phase Differences in Fluxes, and Reaction of Primary on Closing of Secondary, with Practical Factors of Split-Phase Magnet Design and Operation

BY F. HYMANS

IN order to present the subject matter of this article in a clear and concise form, the writer has divided it into separate sections devoted to preliminaries necessary for the derivation of the vector diagram of the split-phase magnet. In Section I the relation is derived between flux components and the corresponding exciting current components. In Section II a core structure, similar in magnetic behavior to the split-phase magnet, is considered, to show that phase differences in the fluxes actually may occur even with open secondary and to derive the manner in which the primary reacts at the closure of the secondary. Sections III, IV and V take up factors of split-phase magnet design. The capital letters used in reference to an emf. or current denote instantaneous values, and the small letters indicate effective values. Capital letters in reference to fluxes denote instantaneous values and small letters maximum values. This article deals only with the type

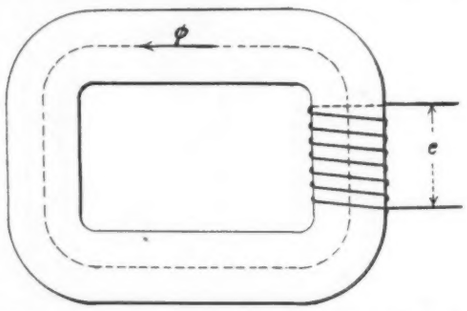


FIG. 1—DIAGRAM OF MAGNET CORE AND COIL

of split-phase magnet known to date, and will be followed up with others on some recent improvements in this type of apparatus.

I—RESOLUTION OF A FLUX IN ITS COMPONENTS

The diagram of Fig. 1 represents a magnet core and a coil wound on a portion of the same, excited by an emf. e. Assuming the coil to be without resistance, the relation between flux, exciting current and emf. is shown in the vector diagram Fig. 2, wherein $OD = e$ is the impressed emf., $OA = \varphi$ the flux lagging 90 deg. behind OD, and $OB = c$ the exciting current leading the flux by the angle α. We can resolve the flux φ in two arbitrary components, φ_1 and φ_2, so that geometrically

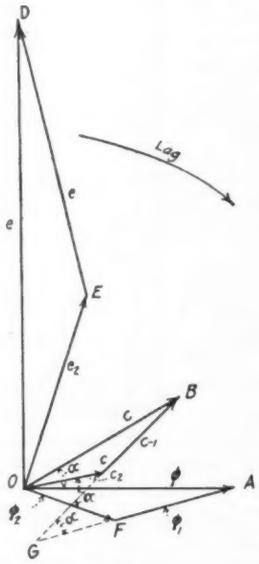


FIG. 2 — RELATION BETWEEN FLUX, EXCITING CURRENT AND ELECTROMOTIVE FORCE FOR CONDITIONS OF FIG. 1.

$$\varphi = \varphi_1 + \varphi_2 \qquad (1)$$

The flux φ_1 will have an exciting current c_1, the flux φ_2 an exciting current c_2, and the problem which we here propose to solve consists in determining the relation which must exist between c_1 and c_2. Since the fluxes φ_1 and φ_2 occur simultaneously, that is, since only the resultant flux φ actually exists, it is clear that the number of lines of force per ampere exciting current must be the same for the resultant flux as well for its component, so that:

$$\frac{\varphi}{c} = \frac{\varphi_1}{c_1} = \frac{\varphi_2}{c_2} \qquad (2)$$

From 1 and 2 we derive

$$c = c_1 + c_2, \qquad (3)$$

which means that the exciting current c, inducing the resultant flux φ, is the resultant of the currents c_1 and c_2, exciting the component fluxes φ_1 and φ_2, as shown in Fig. 2. When thus OAF is the triangle of the fluxes and

OBC the triangle of the corresponding exciting currents, we deduce from the proportionality 2 at once:

(1) The triangle of the fluxes *OAF* and the triangle of the corresponding exciting currents *OBC* are similar, so that $\angle BOA = \angle COF = \angle BGA = \alpha$, and hence:

(2) In the triangles of the exciting currents and of the corresponding fluxes, each exciting current will lead the corresponding flux by the same angle.

In Fig. 2, c leads φ by the given angle α. If we therefore resolve φ in the components φ_2 and φ_1, we obtain the corresponding exciting currents by drawing *OC* and *BG* so as to make an angle α with the directions of *OF* and *FA* respectively, when *CB* will be the exciting current of φ_1 and *OC* of φ_2. Since the fluxes all link with the same spool, it is clear that the impressed emf. e must be the resultant of the emfs., necessary to balance the emfs. of self-induction due to φ_1 and φ_2. Each of the former emfs. leads the corresponding flux by 90 deg. We draw consequently through *D* and *O* lines perpendicularly to the directions of *FA* and *OF*, whence *ED* and *OE* will be the emfs. which induce the fluxes φ_1 and φ_2.

II—Coil Linked with Two Cores of Which One Is Provided with a Secondary

As will be set forth in detail in Section III, the phenomena which take place in the split-phase magnet are identical to those occurring in a core structure as in

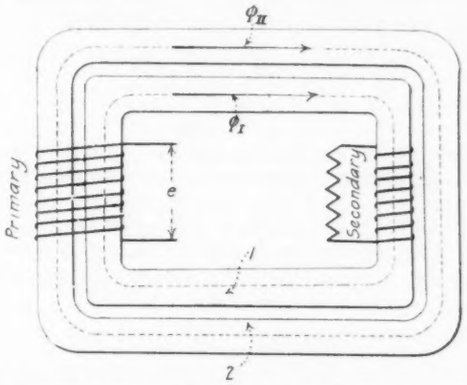


FIG. 3—CORE STRUCTURE USED TO ILLUSTRATE ACTION OF SPLIT-PHASE MAGNET

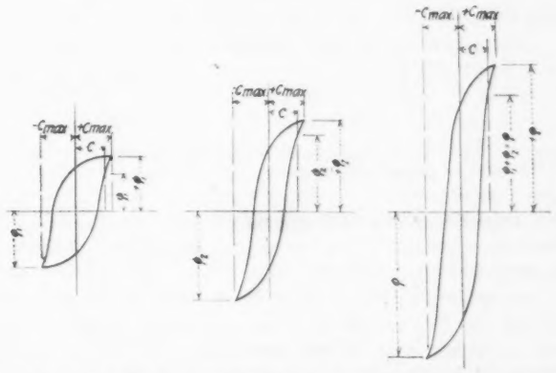
Fig. 3, consisting of two individual cores 1 and 2, simultaneously excited by a single primary spool of n_p turns and provided with a secondary of n_s turns on core 1. Considering first the conditions with open secondary. When the primary is excited a flux φ_1 will be set up in core 1 and a flux φ_2 in core 2. When the two cores have different magnetic properties—each, for instance, having different dimensions, although consisting of the same material—the fluxes φ_1 and φ_2 will neither be in phase nor will their wave form be sinusoidal. These interesting facts can be demonstrated as follows:

Let Figs. 4a and 4b represent the hysteresis loops for the cores 1 and 2 respectively, where flux values are plotted as ordinates against current as abscissæ, C_{max} being the maximum instantaneous value of the exciting current c. At each instant the total flux linking with the primary must be the algebraic sum of the instantaneous flux values induced in core 1 and core 2. We consequently obtain the loop Fig. 4c of the resultant flux by plotting against each instantaneous current value C the sum of the corresponding instantaneous flux values φ_1 in core 1 and φ_2 in core 2, which we obtain immediately from Figs. 4a and 4b. Assuming the primary to have no resistance, all of the impressed emf. must be consumed by the emf. of self-induction due to the linking of the resultant flux with the primary. If, therefore, the impressed emf. is a sine wave, it follows that such must also be the case with the resultant flux.

In Fig. 5a the curve a represents the sine wave form of the resultant flux, instantaneous flux values being plotted against time. The wave form of the exciting current c (Fig. 5b) is derived by ascertaining the value of φ at a given instant from Fig. 5a, whence we obtain from Fig. 4c the corresponding value of the exciting current and plot the latter against the time in Fig. 5b. Knowing at each instant the value of the exciting current, we obtain from Figs. 4a and 4b the corresponding value of the fluxes φ_1 and φ_2, and can plot these values as ordinates in Fig. 5a, where curves b and c will be the wave shapes of the fluxes in core 1 and core 2. The wave forms of these fluxes are no longer simple harmonics; they attain their maximum simultaneously, but φ_2 the flux with the higher maximum value, leads φ_1 by a considerable amount.

Under the conditions in actual magnets the phase difference between the fluxes φ_1 and φ_2 is generally slight, and no material error is made when treating them as harmonics.

In Fig. 6a the conditions with open secondary are thus represented by *OC*, the vector of the flux φ_1 in core 1; *OA*, the vector of the flux φ_2 in core 2; *OH*, the vector of the resultant flux φ, which links with the primary, and *OG*, the vector of the current c, which excites the fluxes φ_1 and φ_2. Upon the closure of the secondary a current c_s will flow through its windings,



FIGS. 4A, 4B AND 4C—HYSTERESIS LOOPS FOR CORES 1 AND 2 OF FIG. 3 AND THE RESULTANT FLUX

and the problem consists in determining the manner in which the primary will react. To distinguish the new conditions from the conditions with open secondary, the primary current will be denoted by c_p and the fluxes in cores 1 and 2 with the secondary closed by φ_I and φ_{II}.

Since the primary is assumed to have no resistance, the impressed emf. must under all conditions be consumed by the emf. of self-induction, caused by the linking of the resultant flux with the primary spool. Consequently the resultant flux φ linking with the primary remains the same with open as well as with closed secondary, and however the fluxes in cores 1 and 2 may be affected by the closure of the secondary, their new phase and magnitude must be such that their resultant remains the flux φ represented by the vector *OH*. Vectorially this is expressed as follows:

With open secondary, $\varphi_1 + \varphi_2 = \varphi$,
with closed secondary, $\varphi_I + \varphi_{II} = \varphi$.
Hence,

$$(\varphi_1 - \varphi_I) = -(\varphi_2 - \varphi_{II}) \qquad (1)$$

But in Fig. 6*a*

$$\varphi_I = \varphi_1 + CD \quad \text{and} \quad \varphi_{II} = \varphi_2 + AE.$$

Substituting for φ_I and φ_{II} in 1, we obtain

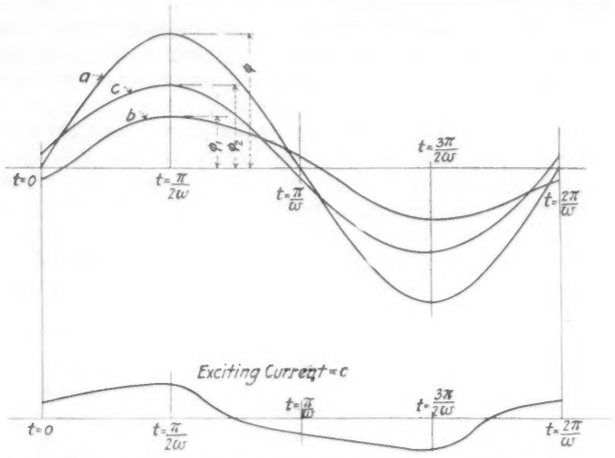
$$CD = -AE \qquad (2)$$

expressing that the vectors *CD* and *AE* are equal, parallel to each other but of opposite directions.

When, however, the closing of the secondary causes the flux in core 1 to change from φ_1 to φ_I and in core 2 from φ_2 to φ_{II}, the changes are measured by the vectors CD and AE respectively and we consequently deduce the following from equation 2 above:

The readjustment which takes place upon the closure of the secondary occurs in such a manner that the vectorial increase in flux in one core is equal to the vectorial decrease in flux in the other.

With the above and the results of Section 1, we are now in a position to determine phase and magnitude of the fluxes in cores 1 and 2 and also of the primary current, upon the closure of the secondary, provided of course that the open secondary conditions as well as phase and magnitude of the secondary current is given.



FIGS. 5A AND 5B—SINE WAVE FORM OF RESULTANT FLUX AND WAVE FORM OF EXCITING CURRENT

Supposing for the present phase and magnitude of the primary current c_p with closed secondary known and represented by OF in Fig. 6a. Considering first core 2, an inspection of Fig. 3 will show that the m.m.f. which excites the flux φ_{II} is $n_p \times c_p$ so that c_p will be the current exciting φ_{II}. If we now join G and F, evidently OGF will be the triangle of the exciting currents and OAE the triangle of the corresponding fluxes in core 2. According to Section I these triangles are similar, and hence

$$\frac{\varphi_2}{c} = \frac{AE}{GF} \tag{3}$$

In the triangle of exciting currents OGF and in the triangle of the corresponding fluxes OAE, OG leads OA by the given angle β, so that in further accordance with Section I, GF leads AE by the same angle, as shown in Figs. 6a and 6b.

Referring now to core 1, an inspection of Fig. 3 will show that the mmf. which excites φ_I is the vector difference between the magnetomotive force $n_p \times c_p$ due to the primary and the demagnetizing mmf. $n_s \times c_s$ due to the secondary. The resultant mmf. is expressed by

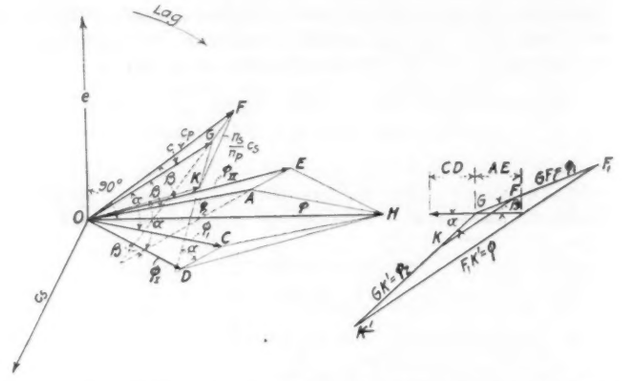
$$n_p c_p - n_s c_s = n_p \left(c_p - \frac{n_s}{n_p} c_s \right)$$

and is consequently equivalent to a current $c_p - \frac{n_s}{n_p} c_s$ flowing through the n_p turns of the primary. If in Fig. 6a, c_s is the vector of the secondary current, we draw $FK = \frac{n_s}{n_p} c_s$ parallel to c_s, whence OK will be the vector difference of the current c_p and a current of magnitude $\frac{n_s}{n_p} c_s$ and phase c_s, and will be the exciting current of the flux φ_1. By joining K and G, OGK will be the triangle of the exciting currents and OCD the triangle of the corresponding fluxes. In these triangles, OG leads OC by the given angle α and consequently GK leads CD by the same angle. The relative relation between the vectors GK and CD is also shown in Fig. 6b, wherein CD is drawn equal but opposite to AE in accordance with equation 2. The above triangles OKG and OCD are similar according to Section I, so that

$$\frac{\varphi_1}{c} = \frac{CD}{GK} \tag{4}$$

Since by equation 2, CD and AE are numerically equal, we deduce from 3 and 4 $\quad \frac{\varphi_1}{GF} = \frac{\varphi_2}{GK}$ (5)

If now in Fig. 6b we make $GF_1 = \varphi_1$ and $GK' = \varphi_2$, it is clear that F_1K' is the resultant of φ_1 and φ_2, and must



FIGS. 6A AND 6B—VECTOR DIAGRAMS FOR CONDITIONS WITH OPEN SECONDARY AND CLOSED SECONDARY

therefore be equal to $OH = \varphi$ of Fig. 6a. On account of the proportionality 5, we further deduce that triangles GFK and GF_1K' of Fig. 6b are similar, so that

$$\frac{GF}{\varphi_1} = \frac{GK}{\varphi_2} = \frac{FK}{\varphi}$$

Triangle GFK of Fig. 6b is merely a reproduction of the same triangle of Fig. 6a, wherein as stated before $FK = \frac{n_s}{n_p} c_s$. Substituting in the above for FK, we obtain

$$\frac{GF}{\varphi_1} = \frac{GK}{\varphi_2} = \frac{\frac{n_s}{n_p} c_s}{\varphi} \tag{6}$$

How to construct the diagram for closed secondary when the open secondary conditions are given is now clear, for, with the latter known, triangle GF_1K' of Fig. 6b can at once be drawn. If in addition the phase and magnitude of the secondary current is given, we can draw in Fig. 6b FK parallel to F_1K' and of such length that $FK = \frac{n_s}{n_p} c_s$. Transporting there upon triangle GFK of Fig. 6b to Fig. 6a, but so that the side FK is parallel with the direction of c_s, we obtain at once OF, the vector of the primary current, which excites the flux φ_{II} in core 2 as well as OK, the vector of the exciting current of the flux φ_I in core 1. Applying again the theorem of the triangles of exciting currents and corresponding fluxes, we find easily that OF leads φ_{II} by the angle β and OK leads φ_I by the angle α. Making therefore, $\angle FOE = \beta$ and $\angle KOD = \alpha$ we obtain the phase of φ_{II} and of φ_I, and since $OH = \varphi$ must be their resultant, their magnitudes are readily determined.

In another section of this article to appear in a later issue, practical factors of split-phase magnet design and operation will be discussed.

Losses in Cables Armored with Steel Tape

Results of Experiments to Determine the Losses Due to Steel Tapes of Cables Provided with Coverings of Lead and Steel Tape When Carrying Different Values of Current

BY W. I. MIDDLETON AND E. W. DAVIS

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THE experiments described in what follows here and the accompanying data are the result of an investigation conducted by the writers to determine the losses due to steel tape when applied to lead-covered cable for use instead of lead cable in conduit. The first series of experiments were made on a length of 300 ft. No. 6 B. & S. solid conductor insulated with a 5/32 in. wall of rubber and tape. After a 0.0625-in. wall of lead was applied to this wire, the losses in the cable were measured with different values of alternating current with the cable in loops, first with the sides of the loop touching, then 1 ft. apart, then 4 ft. apart, and finally 20 ft. apart. Tests were made with the lead open across the ends of the loop, and with the lead short-circuited across the ends.

After these tests, the lead cable was served with 100 lb. tarred jute, armored with two steel tapes No. 20 B. W. G. (0.035 in.), wound spirally in reverse, and again served with 100 lb. tarred jute. Similar experiments were made on this cable with different current values at different distances between the sides of the loop, but owing to the steel tape, other combinations of open and short-circuited sheath were studied as follows: (1) Lead sheath open and steel tapes open across the end of the loop. (2) Lead sheath short-circuited and steel tapes open. (3) Lead open and steel tapes short-circuited. (4) Both lead and steel tapes short-circuited.

The results of the experiments first carried out on the No. 6 solid wire proved conclusively that when used in alternating-current circuits, carrying not more than 6 or 7 amp., the losses are small, and that the cables can be used with the same freedom as direct-current cables. While this statement is true for this cable with small current, when the current is increased the losses increase so rapidly that it is not practical under ordinary conditions to use single conductor iron armored cables on alternating-current circuits.

Experiments were also carried out on a No. 4/0 single-conductor lead and iron-armored cable to show how large these losses may be in cables of this class when carrying heavy currents.

The increase in the losses of a single-conductor iron-armored cable on alternating-current circuits as compared with direct-current losses, may be divided into three parts: (1) There is an increase in the effective resistance of the copper conductor due to the increased magnetic field surrounding it. (2) There are secondary currents in the lead sheath and steel tape. These currents are similar to those set up in the secondary of a transformer and are increased or decreased by the magnetic circuit. (3) There are hysteresis and eddy current losses corresponding to the core losses of a transformer. It is evident that anyone of these losses is increased by the iron armor.

Inasmuch as all three of these losses depend upon the magnetic field surrounding the conductor, they must be proportional to some power of the current in it and the distance between the sides of the circuit.

A test was made on the No. 6 armored cable in water to compare with results of tests made on the cable when looped on the wall. All tests were made with 25-cycle and 60-cycle current. No commercial wattmeter is available for work of this kind, because of the very low voltages and the wide range of current to be measured. It was, therefore, necessary to use an instrument of special design. The wattmeter used was a torsion head instrument, with a fixed current coil and moving potential coil. It was necessary to use several current coils of different electrical dimensions varying from 100 turns of No. 12 to three turns of No. 4/0. The cross-section of the No. 4/0 being so large, the possibility of error due to eddy currents in the copper was considered, and it was decided to use a coil made of 0.25 in. copper tubing with a 0.0625-in. wall. To keep the copper tubing from overheating, cold water was circulated through the coil. Tests showed that the water had no effect upon the meter readings.

The moving coil of the instrument consisted of 200 turns of No. 34 cotton-covered wire. In the test on the No. 4/0 cable, this coil was used in series with several hundred ohms. The meter frame, supports, and casing were constructed of brass and hard rubber, there being no magnetic substances in or near the instrument. A test to determine the inductance in the moving and stationary coils showed it to be negligible.

The voltage drop between the ends of the conductor, the lead sheath, and the steel tape was obtained by means of a Sumpner Reflecting Electrodynamometer, which is a highly sensitive alternating-current galvanometer. The design of this instrument makes it independent of wave form, frequency, and external magnetic fields. All other measurements were made with commercial instruments.

The dimensions of the No. 6 cable were as follows:

Length	305 ft.
Size of conductor No. 6 solid B. & S.	0.162 in.
Wall of rubber insulation	5/32 in.
Diameter over insulation	15/32 in.
Diameter over lead sheath	20/32 in.
Diameter over outer steel tape	30/32 in.

Two steel tapes 0.75 in. by 0.035 in. put on in reverse directions were used. The outside diameter over the serves was 35/32 in.

Table II shows the values of the effective resistance of the No. 6 cable before armoring to increase with increase of current in the conductor, with increase of distance between the sides of the circuit, and with lead sheath short-circuited.

With an increase of current, there is an increase of flux around the conductor, together with an increase of eddy currents in the lead sheath, accordingly an increase of the effective resistance of the cable. The increase of effective resistance with distance of separa-

TABLE I—SECONDARY CURRENTS IN LEAD SHEATH FOR NO. 6 SOLID CONDUCTOR WITH 5/32-IN. WALL INSULATION, LEAD COVERED WITH LEAD SHEATH SHORT CIRCUITED

Position of Sides of Loop	Amp in Cond.	25 ~	60 ~
Touching	6.6	0	0
	15.0	0	0.20
	30.0	0.10	0.50
1 ft. apart	6.6	0	0.30
	15.0	0.20	0.80
	30.0	0.65	1.57
4 ft. apart	6.6	0	0.40
	15.0	0.10	0.90
	30.0	0.55	1.80
Around room	6.6	0.20	0.50
	15.0	0.60	1.30
	30.0	0.96	2.72

Results of Tests on Lead-Covered Cable Armored with Steel Tape

TABLE II—EFFECTIVE RESISTANCE IN OHMS PER 1000 FT. FOR NO. 6 SOLID CONDUCTOR WITH 5/32-IN. WALL INSULATION, LEAD COVERED

Position of Sides of Loop	Amp. in Cond.	Rdc.	Lead Open				Lead Short			
			25 ~		60 ~		25 ~		60 ~	
			Refl.	Refl. / Rdc.	Refl.	Refl. / Rdc.	Refl.	Refl. / Rdc.	Refl.	Refl. / Rdc.
Touching	6.6	0.394	0.395	1.002	0.397	1.007	0.396	1.005	0.401	1.017
	15.0	0.394	0.399	1.012	0.406	1.029	0.402	1.020	0.407	1.033
	30.0	0.394	0.401	1.017	0.407	1.033	0.404	1.025	0.408	1.035
1 ft. apart	6.6	0.394	0.397	1.007	0.400	1.015	0.398	1.010	0.405	1.027
	15.0	0.394	0.401	1.017	0.407	1.033	0.403	1.022	0.408	1.035
	30.0	0.394	0.404	1.025	0.409	1.035	0.406	1.029	0.409	1.038
4 ft. apart	6.6	0.394	0.398	1.010	0.403	1.022	0.399	1.012	0.407	1.033
	15.0	0.394	0.402	1.020	0.408	1.035	0.405	1.029	0.409	1.037
	30.0	0.394	0.404	1.028	0.409	1.035	0.406	1.035	0.410	1.040
Around room	6.6	0.394	0.399	1.012	0.405	1.027	0.402	1.020	0.408	1.035
	15.0	0.394	0.406	1.029	0.409	1.038	0.408	1.035	0.410	1.040
	30.0	0.394	0.408	1.038	0.410	1.040	0.410	1.040	0.411	1.042

TABLE III—IMPEDANCE IN OHMS PER 1000 FT. FOR NO. 6 SOLID CONDUCTOR WITH 5/32-IN. WALL INSULATION, LEAD COVERED

Position of Sides of Loop	Amp. in Cond.	Rdc.	Lead Open				Lead Short			
			25 ~		60 ~		25 ~		60 ~	
			Z	Z / Rdc.	Z	Z / Rdc.	Z	Z / Rdc.	Z	Z / Rdc.
Touching	6.6	0.394	0.398	1.010	0.418	1.060	0.401	1.017	0.426	1.081
	15.0	0.394	0.413	1.032	0.419	1.063	0.415	1.053	0.429	1.088
	30.0	0.394	0.430	1.090	0.438	1.110	0.435	1.104	0.432	1.146
1 ft. apart	6.6	0.394	0.412	1.045	0.430	1.065	0.414	1.050	0.440	1.116
	15.0	0.394	0.418	1.060	0.430	1.090	0.418	1.063	0.445	1.128
	30.0	0.394	0.427	1.106	0.442	1.121	0.438	1.110	0.444	1.176
4 ft. apart	6.6	0.394	0.429	1.085	0.430	1.090	0.425	1.077	0.448	1.136
	15.0	0.394	0.429	1.088	0.431	1.094	0.430	1.090	0.456	1.151
	30.0	0.394	0.436	1.110	0.449	1.139	0.440	1.116	0.460	1.207
Around room	6.6	0.394	0.430	1.090	0.434	1.101	0.435	1.104	0.452	1.194
	15.0	0.394	0.435	1.104	0.462	1.172	0.438	1.110	0.477	1.210
	30.0	0.394	0.440	1.116	0.484	1.227	0.444	1.126	0.500	1.267

TABLE IV—EFFECTIVE RESISTANCE IN OHMS PER 1000 FT. FOR NO. 6 SOLID CONDUCTOR WITH 5/32-IN. WALL INSULATION, LEAD COVERED AND STEEL TAPED

Position of Sides of Loop	Amp. in Cond.	Rdc.	Lead Open, Steel Open		Lead Short, Steel Open		Lead Short, Steel Short		Lead Open, Steel Short	
			25 ~	60 ~	25 ~	60 ~	25 ~	60 ~	25 ~	60 ~
			Refl.	Refl.	Refl.	Refl.	Refl.	Refl.	Refl.	Refl.
Touching	6.6	0.394	0.408	0.452	0.438	0.540	0.416	0.456	0.410	0.461
	15.0	0.394	0.413	0.504	0.463	0.618	0.418	0.496	0.417	0.508
	30.0	0.394	0.461	0.628	0.469	0.648	0.539	0.544	0.431	0.662
1 ft. apart	6.6	0.394	0.438	0.506	0.451	0.564	0.458	0.481	0.413	0.496
	15.0	0.394	0.460	0.546	0.484	0.666	0.467	0.560	0.422	0.535
	30.0	0.394	0.489	0.653	0.533	0.672	0.540	0.563	0.435	0.731
4 ft. apart	6.6	0.394	0.466	0.514	0.466	0.619	0.476	0.521	0.457	0.512
	15.0	0.394	0.489	0.549	0.496	0.675	0.479	0.533	0.461	0.572
	30.0	0.394	0.504	0.665	0.550	0.732	0.543	0.647	0.487	0.760
Around room	6.6	0.394	0.471	0.520	0.488	0.625	0.486	0.740	0.464	0.522
	15.0	0.394	0.500	0.571	0.499	0.678	0.488	0.811	0.474	0.598
	30.0	0.394	0.609	0.720	0.557	0.875	0.545	0.825	0.557	0.841
Coiled in water	6.6	0.394	0.396	0.443	0.407	0.521	0.433	0.553	0.401	0.450
	15.0	0.394	0.474	0.515	0.505	0.626	0.491	0.563	0.470	0.516
	30.0	0.394	0.560	0.809	0.591	0.734	0.574	0.858	0.573	0.849

TABLE V—WATTS LOSS PER 1000 FT. FOR NO. 6 SOLID CONDUCTOR WITH 5/32-IN. WALL INSULATION, LEAD COVERED AND STEEL TAPED

Position of Sides of Loop	Amp. in Cond.	Watts per 1000 Ft. D.C.	Lead Open, Steel Open		Lead Short, Steel Open		Lead Short, Steel Short		Lead Open, Steel Short	
			Watts per 1000 ft.		Watts per 1000 ft.		Watts per 1000 ft.		Watts per 1000 ft.	
			25 ~	60 ~	25 ~	60 ~	25 ~	60 ~	25 ~	60 ~
Touching	6.6	17.18	17.77	19.70	19.06	23.56	18.13	19.96	17.85	20.02
	15.0	88.69	92.90	103.40	104.60	138.80	93.50	111.00	93.90	114.50
	30.0	355.00	413.00	560.00	416.50	563.80	480.80	690.00	388.00	598.00
1 ft. apart	6.6	17.18	19.06	22.04	19.06	24.20	19.95	20.95	18.90	21.62
	15.0	88.69	103.50	122.80	109.00	150.50	103.30	125.00	99.00	120.60
	30.0	355.00	512.00	683.00	479.00	650.00	486.00	500.00	405.00	558.00
4 ft. apart	6.6	17.18	20.30	22.46	20.35	26.95	20.85	27.10	19.90	22.32
	15.0	88.69	106.50	122.60	111.90	151.80	107.90	142.50	103.90	129.70
	30.0	355.00	525.50	617.00	495.60	656.00	495.70	583.00	438.50	604.00
Around room	6.6	17.18	20.30	22.05	20.45	27.25	21.18	23.20	20.15	22.73
	15.0	88.69	112.50	139.50	112.30	152.70	110.00	183.10	106.40	134.60
	30.0	355.00	602.00	646.00	501.50	737.00	491.00	743.00	468.00	758.00
Coiled in water	6.6	17.18	17.95	19.60	17.74	22.70	18.86	24.10	17.45	19.60
	15.0	88.69	102.00	115.00	113.00	140.90	110.50	149.50	105.70	116.50
	30.0	355.00	506.00	720.00	533.00	681.00	516.50	773.30	516.00	736.00

NOTE.—The rate of increase of losses with distance of separation is large up to about 6 ft. Beyond that point it is small.

TABLE VI—IMPEDANCE IN OHMS PER 1000 FT. FOR NO. 6 SOLID CONDUCTOR WITH 5/32-IN. WALL INSULATION, LEAD COVERED AND STEEL TAPED

Position of Sides of Loop	Amp. in Cond.	Rdc.	Lead Open, Steel Open		Lead Short, Steel Open		Lead Short, Steel Short		Lead Open, Steel Short	
			25 ~	60 ~	25 ~	60 ~	25 ~	60 ~	25 ~	60 ~
			Z	Z	Z	Z	Z	Z	Z	Z
Touching	6.6	0.394	0.450	0.581	0.477	0.553	0.450	0.466	0.466	0.557
	15.0	0.394	0.453	0.807	0.535	0.851	0.453	0.705	0.474	0.940
	30.0	0.394	0.538	1.415	0.663	0.973	0.651	0.878	0.646	1.303
1 ft. apart	6.6	0.394	0.460	0.591	0.485	0.610	0.490	0.613	0.468	0.622
	15.0	0.394	0.524	0.933	0.552	0.905	0.502	0.820	0.482	0.922
	30.0	0.394	0.756	1.480	0.804	0.980	0.680	0.934	0.704	1.454
4 ft. apart	6.6	0.394	0.492	0.726	0.497	0.733	0.496	0.732	0.481	0.744
	15.0	0.394	0.554	0.971	0.575	0.865	0.560	0.890	0.532	0.991
	30.0	0.394	0.837	1.509	0.739	1.089	0.710	0.978	0.770	1.594
Around room	6.6	0.394	0.520	0.760	0.502	0.732	0.496	0.960	0.486	0.749
	15.0	0.394	0.600	0.992	0.595	0.994	0.599	1.014	0.589	1.000
	30.0	0.394	0.880	1.560	0.760	1.267	0.779	1.115	0.822	1.635
Coiled in water	6.6	0.394	0.419	0.639	0.462	0.854	0.467	0.870	0.453	0.640
	15.0	0.394	0.557	0.803	0.595	0.790	0.584	0.865	0.556	0.796
	30.0	0.394	0.751	1.330	0.679	0.929	0.689	0.924	0.734	1.360

TABLE VII—VOLTS DROP PER 1000 FT. FOR NO. 6 SOLID CONDUCTOR WITH 5/32-IN. WALL INSULATION, LEAD COVERED AND STEEL TAPED

Position of Sides of Loop	Amp. in Cond.	Volts Drop per 1000 Ft. D.C.	Lead Open, Steel Open		Lead Short, Steel Open		Lead Short, Steel Short		Lead Open, Steel Short	
			Volts drop per 1000 ft.		Volts drop per 1000 ft.		Volts drop per 1000 ft.		Volts drop per 1000 ft.	
			25 ~	60 ~	25 ~	60 ~	25 ~	60 ~	25 ~	60 ~
Touching	6.6	2.60	2.97	3.51	3.15	2.65	2.97	3.08	3.06	3.68
	15.0	13.91	14.62	16.30	16.45	21.76	14.62	17.56	14.75	18.09
	30.0	111.94	129.15	176.00	130.99	177.13	151.50	217.00	122.00	188.00
1 ft. apart	6.6	2.60	2.94	3.90	3.21	4.03	3.24	4.05	3.00	4.11
	15.0	5.91	7.98	14.00	8.28	12.69	7.35	11.00	7.33	13.82
	30.0	22.10	44.60	68.60	49.94	89.10	39.40	88.00	32.80	83.67
4 ft. apart	6.6	2.60	3.35	4.86	3.38	4.54	3.28	4.54	3.17	4.91
	15.0	5.91	8.27	14.60	8.63	13.39	8.70	13.30	8.58	14.90
	30.0	11.94	23.30	46.50	21.87	36.60	21.37	29.26	22.30	46.12
Around room	6.6	2.60	3.43	4.95	3.33	4.98	3.29	5.04	3.21	4.95
	15.0	5.91	9.60	14.90	9.92	14.80	8.99	13.20	8.94	15.00
	30.0	11.94	26.40	47.70	25.71	36.01	23.40	33.45	24.05	49.05
Coiled in water	6.6	2.60	2.77	4.15	3.05	4.52	3.00	4.42	2.99	4.33
	15.0	5.91	8.35	12.60	8.49	11.90	8.45	12.10	8.34	11.90
	30.0	11.94	22.55	39.90	20.40	27.89	20.35	27.72	22.03	40.90

TABLE VIII—EFFECTIVE RESISTANCE IN OHMS PER 1000 FT. FOR NO. 4/0 CABLE 5/64-IN. WALL INSULATION, LEAD COVERED

Position of Sides of Loop	Amp. in Cond.	Rdc.	Lead Open				Lead Short			
			25 ~		60 ~		25 ~		60 ~	
			Refl.	Refl. / Rdc.	Refl.	Refl. / Rdc.	Refl.	Refl. / Rdc.	Refl.	Refl. / Rdc.
Touching	150	0.0481	0.0485	1.008	0.0490	1.017	0.0490	1.017	0.0500	1.038
	225	0.0481	0.0490	1.017	0.0494	1.026	0.0501	1.041	0.0503	1.043
	300	0.0481	0.0498	1.035	0.0515	1.070	0.0514	1.067	0.0523	1.086
1 ft. apart	150	0.0481	0.0490	1.017	0.0510	1.059	0.0499	1.036	0.0550	1.142
	225	0.0481	0.0499	1.036	0.0520	1.080	0.0526	1.092	0.0577	1.198
	300	0.0481	0.0514	1.067	0.0529	1.098	0.0542	1.126	0.0602	1.251
4 ft. apart	150	0.0481	0.0501	1.041	0.0517	1.074	0.0512	1.064	0.0615	1.276
	225	0.0481	0.0517	1.074	0.0540	1.122	0.0537	1.115	0.0703	1.452
	300	0.0481	0.0532	1.105	0.0547	1.136	0.0551	1.145	0.0720	1.496
15 ft. circle	150	0.0481	0.0525	1.090	0.0538	1.117	0.0526	1.092	0.0760	1.314
	225	0.0481	0.0536	1.114	0.0573	1.190	0.0574	1.192	0.0760	1.580
	300	0.0481	0.0554	1.152	0.0590	1.226	0.0581	1.206	0.0772	1.604

TABLE X—IMPEDANCE IN OHMS PER 1000 FT. FOR NO. 4/0 CABLE, 5/64-IN. WALL INSULATION, LEAD COVERED

Position of Sides of Loop	Amp. in Cond.	Rdc.	Lead Open		Lead Short	
			25 ~	60 ~	25 ~	60 ~
			Z	Z / Rdc.	Z	Z / Rdc.
Touching	150	0.0481	0.0502	1.147	0.0506	1.156
	225	0.0481	0.0557	1.156	0.0559	1.161
	300	0.0481	0.0660	1.162	0.0727	1.511
1 ft. apart	150	0.0481	0.0644	1.334	0.0654	1.359
	225	0.0481	0.0654	1.359	0.0659	1.369
	300	0.0481	0.0655	1.362	0.0660	1.390
4 ft. apart	150	0.0481	0.0656	1.431	0.0701	1.456
	225	0.0481	0.0657	1.477	0.0703	1.459
	300	0.0481	0.0659	1.482	0.0707	1.469
Around room	150	0.0481	0.0630	1.309	0.0675	2.036
	225	0.0481	0.0679	1.410	0.0675	2.036
	300	0.0481	0.0672	2.040	0.0695	2.283

TABLE IX—EFFECTIVE RESISTANCE IN OHMS PER 1000 FT. FOR NO. 4/0 CABLE 5/64-IN. WALL INSULATION, LEAD COVERED AND STEEL TAPED

Position of Sides of Loop	Amp. in Cond.	Rdc.	Lead Open, Steel Open		Lead Short, Steel Open		Lead Short, Steel Short		Lead Open, Steel Short	
			25 ~	60 ~	25 ~	60 ~	25 ~	60 ~	25 ~	60 ~
			Refl.	Refl.	Refl.	Refl.	Refl.	Refl.	Refl.	Refl.
Touching	150	0.0481	0.166	0.415	0.360	0.644	0.262	0.522	0.190	0.590
	225	0.0481	0.112	0.263	0.253	0.647	0.262	0.631	0.129	0.370
	300	0.0481	0.091	0.199	0.222	0.601	0.249	0.585	0.105	0.260
1 ft. apart	150	0.0481	0.168	0.421	0.366	0.638	0.372	0.383	0.193	0.591
	225	0.0481	0.113	0.265	0.266	0.641	0.275	0.629	0.136	0.372
	300	0.0481	0.0944	0.191	0.202	0.600	0.208	0.589	0.105	0.261
4 ft. apart	150	0.0481	0.170	0.427	0.375	0.657	0.277	0.390	0.197	0.382
	225	0.0481	0.116	0.268	0.274	0.630	0.282	0.610	0.137	0.373
	300	0.0481	0.095	0.193	0.212	0.597	0.221	0.588	0.108	0.264
15 ft. circle	150	0.0481	0.171	0.446	0.379	0.695	0.283	0.370	0.208	0.393
	225	0.0481	0.122	0.268	0.281	0.612	0.290	0.386	0.142	0.377
	300	0.0481	0.095	0.195	0.217	0.589	0.224	0.585	0.110	0.269

TABLE XI—SECONDARY CURRENTS IN LEAD SHEATH AND STEEL TAPE FOR NO. 4/0 CABLE, 5/64-IN. WALL INSULATION, LEAD COVERED AND STEEL TAPED

Position of Sides of Loop	Amp. in Cond.	Lead Short, Steel Open		Lead Short, Steel Short				Lead Open, Steel Short	
		Lead amperes		Lead amperes		Steel tape amperes		Steel tape amperes	
		25 ~	60 ~	25 ~	60 ~	25 ~	60 ~	25 ~	60 ~
Touching	150	66.4	116.0	78.0	110.4	10.7	14.0	13.1	32.0
	225	97.8	140.0	93.9	164.0	13.2	22.2	14.9	37.4
	300	100.2	214.0	108.0	204.0	14.9	29.2	16.0	40.0
1 ft. apart	150	81.0	116.4	79.0	110.8	10.8	15.0	13.2	32.4
	225	99.0	118.0	96.0	167.4	13.5	23.5	15.4	38.4
	300	111.0	218.0	110.4	208.4	13.25	29.5	16.7	42.2
4 ft. apart	150	82.0	117.0	80.0	111.0	11.2	15.0	13.9	32.4
	225	103.8	169.6	100.4	168.0	14.3	23.5	15.1	38.5
	300	116.4	221.0	113.2	208.8	16.3	29.3	17.7	42.6
15 ft. apart	150	82.8	120.0	81.0	111.4	11.7	15.0	14.3	33.8
	225	102.6	170.4	101.0	169.0	14.6	24.0	15.6	42.1
	300	116.4	220.2	110.4	214.8	16.9	30.5	18.3	47.0

TABLE XII—IMPEDANCE IN OHMS PER 1000 FT. FOR NO. 4/0 CABLE, 5/64-IN. WALL INSULATION, LEAD COVERED AND STEEL TAPED

Position of Sides of Loop	Amp. in Cond.	Rdc.	Lead Open, Steel Open		Lead Short, Steel Open		Lead Short, Steel Short		Lead Open, Steel Short	
			25 ~	60 ~	25 ~	60 ~	25 ~	60 ~	25 ~	60 ~
			Z	Z	Z	Z	Z	Z	Z	Z
Touching	150	0.0481	0.532	1.365	0.444	0.709	0.440	0.688	0.533	1.320
	225	0.0481	0.412	1.063	0.394	0.716	0.383	0.668	0.408	1.031
	300	0.0481	0.339	0.866	0.328	0.689	0.326	0.564	0.336	0.844
1 ft. apart	150	0.0481	0.547	1.368	0.470	0.704	0.489	0.678	0.537	1.326
	225	0.0481	0.420	1.065	0.393	0.709	0.393	0.679	0.418	1.046
	300	0.0481	0.347	0.861	0.327	0.686	0.335	0.652	0.345	0.854
4 ft. apart	150	0.0481	0.565	1.385	0.483	0.709	0.476	0.670	0.595	1.327
	225	0.0481	0.426	1.091	0.407	0.725	0.404	0.674	0.433	1.048
	300	0.0481	0.363	0.960	0.351	0.660	0.350	0.660	0.362	0.891
15 ft. circle	150	0.0481	0.570	1.385	0.467	0.640	0.480	0.635	0.572	1.329
	225	0.0481	0.442	1.095	0.412	0.670	0.409	0.639	0.430	1.056
	300	0.0481	0.365	0.990	0.355	0.667	0.353	0.637	0.366	0.900

TABLE XIII—REACTANCE IN OHMS PER 1000 FT. FOR NO. 4/0 CABLE, 5/64-IN. WALL INSULATION, LEAD COVERED AND STEEL TAPED

Position of Sides of Loop	Amp. in Cond.	Lead Open, Steel Open		Lead Short, Steel Open		Lead Short, Steel Short		Lead Open, Steel Short	
		X per 1000 ft.		X per 1000 ft.		X per 1000 ft.		X per 1000 ft.	
		25 ~	60 ~	25 ~	60 ~	25 ~	60 ~	25 ~	60 ~
Touching	150	0.505	1.279	0.408	0.341	0.351	0.292	0.498	1.180
	225	0.386	1.010	0.290	0.300	0.279	0.275	0.387	0.962
	300	0.317	0.843	0.263	0.263	0.263	0.256	0.329	0.803
1 ft. apart	150	0.520	1.301	0.395	0.299	0.386	0.324	0.501	1.187
	225	0.402	1.034	0.280	0.304	0.280	0.265	0.395	0.976
	300	0.334	0.869	0.270	0.231	0.262	0.301	0.329	0.845
4 ft. apart	150	0.540	1.316	0.395	0.299	0.290	0.318	0.511	1.199
	225	0.412	1.048	0.301	0.296	0.279	0.288	0.406	0.979
	300	0.350	0.939	0.279	0.294	0.272	0.299	0.345	0.854
15 ft. circle	150	0.544	1.322	0.396	0.299	0.289	0.271	0.533	1.189
	225	0.425	1.061	0.302	0.256	0.287	0.231	0.416	1.056
	300	0.354	0.971	0.281	0.312	0.273	0.282	0.348	0.930

TABLE XIV—WATTS LOSS PER 1000 FT. FOR NO. 4/0 CABLE, 5/64-IN. WALL INSULATION, LEAD COVERED AND STEEL TAPED

Position of Sides of Loop	Amp. in Cond.	Watts per 1000 Ft. D.C.	Lead Open, Steel Open		Lead Short, Steel Open		Lead Short, Steel Short		Lead Open, Steel Short	
			Watts per 1000 ft.		Watts per 1000 ft.		Watts per 1000 ft.		Watts per 1000 ft.	
			25 ~	60 ~	25 ~	60 ~	25 ~	60 ~	25 ~	60 ~
Touching	150	1.053	3.730	9.340	8.160	14.500	8.140	14.000	4.300	12.280
	225	2.435	5.710	13.320	12.810	32.730	13.260	31.820	6.960	15.750
	300	4.328	8.190	17.100	17.280	54.000	17.910	53.550	9.081	23.405
1 ft. apart	150	1.053	3.780	9.470	8.280	14.360	8.270	13.380	4.362	13.300
	225	2.435	5.725	13.420	13.480	32.430	13.930	31.540	6.990	18.840
	300	4.328	8.496	17.700	18.180	54.000	18.720	53.000	9.092	23.508
4 ft. apart	150	1.053	3.920	9.510	8.440	14.330	8.480	13.270	4.455	13.330
	225	2.435	5.940	13.460	13.870	32.350	14.280	31.220	6.930	18.960
	300	4.328	8.541	17.370	19.080	53.730	18.880	52.930	9.702	23.760
15 ft. circle	150	1.053	3.930	10.040	8.530	13.030	8.510	12.930	4.070	13.350
	225	2.435	6.170	13.590	14.240	31.020	14.080	30.930	7.165	19.080
	300	4.328	8.631	17.530	19.530	53.100	20.160	52.050	9.969	24.210

TABLE XV—VOLTS DROP PER 1000 FT. FOR NO. 4/0 CABLE, 5/64-IN. WALL INSULATION, LEAD COVERED AND STEEL TAPED

Position of Sides of Loop	Amp. in Cond.	Volts per 1000 Ft. D.C.	Lead Open, Steel Open		Lead Short, Steel Open		Lead Short, Steel Short		Lead Open, Steel Short	
			Volts per 1000 ft.		Volts per 1000 ft.		Volts per 1000 ft.		Volts per 1000 ft.	
			25 ~	60 ~	25 ~	60 ~	25 ~	60 ~	25 ~	60 ~
Touching	150	7.22	79.8	203.0	86.6	108.4	86.0	102.9	79.9	197.9
	225	16.82	92.6	235.0	98.4	161.2	85.2	154.9	92.0	232.0
	300	14.43	101.7	238.8	102.1	206.7	97.8	203.1	100.8	253.7
1 ft. apart	150	7.22	92.0	200.1	78.5	105.6	76.4	101.6	81.5	198.9
	225	16.82	94.5	240.0	98.4	159.5	98.4	152.8	94.0	233.3
	300	14.43	104.1	267.3	101.1	205.6	100.5	198.0	103.5	262.2
4 ft. apart	150	7.22	94.7	207.0	72.4	102.0	71.4	100.5	84.9	200.1
	225	16.82	98.5	243.2	97.6	126.6	90.9	151.6	96.5	236.0
	300	14.43	108.9	280.0	100.3	204.0	105.0	198.0	108.6	267.9
15 ft. circle	150	7.22	95.5	209.3	72.0	96.0	72.0	95.2	85.8	199.4
	225	16.82	99.4	246.2	92.7	150.8	92.0	143.8	98.8	237.5
	300	14.43	109.5	297.0	106.5	200.1	103.9	191.1	109.8	270.0

tion is due to the fact that when any two wires of the same circuit are separated, the flux linking either wire is increased. With the lead sheath short-circuited, there are secondary currents in it, as shown in Table I. These currents cause an I^2R loss in the lead, which must be considered as a cable loss and is apparent by the increase of effective resistance.

Table IV shows the value of the effective resistance

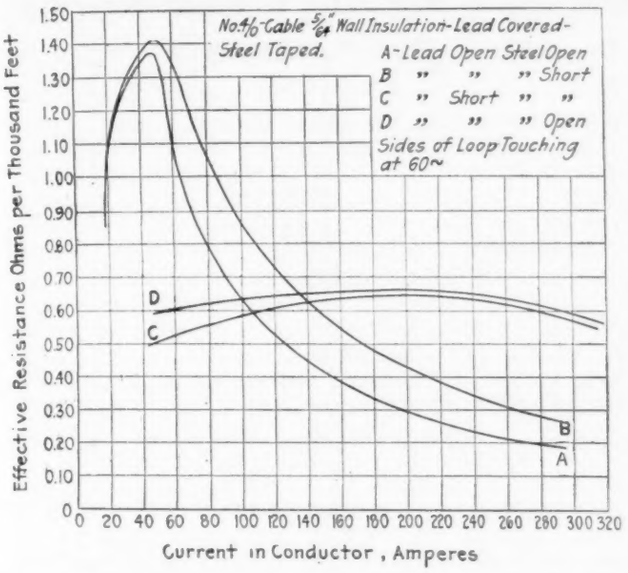


FIG. 1—EFFECTIVE RESISTANCE FOR NO. 4/0 CABLE WITH 5/64-IN. WALL INSULATION, LEAD COVERED AND STEEL TAPED

of this cable when armored. A comparison of the data of Table II and Table IV shows the effect of the steel tape on the effective resistance of the cable. The increase in effective resistance when carrying 6.6 amp., is not sufficient to interfere with its use on 25 and 60-cycle circuits.

Table VI and VII show that the drop in voltage of this cable when used for series lighting circuits when carrying not more than 6 or 7 amp. is not large enough to be of importance.

As previously mentioned, tests were made on a No. 4/0 cable of similar design to determine the possible magnitude of voltage and power losses, and to prove that the use of such cables for large currents is impracticable. A section of 300 ft. of No. 4/0 cable with 5/64-in. wall of rubber insulation lead covered was tested under the same conditions as the No. 6, except that currents of 150, 225 and 300 amp. were used.

Table VIII shows the values of effective resistance of this cable. Table I and Table VIII show that there is an increase in effective resistance with change of condition in the No. 4/0 cable, similar to that of the No. 6 cable.

The impedance of this cable in ohms per 1000 ft. is shown in Table IX. When attempts were made to determine the losses in the No. 4/0 cable armored, it was found that the apparatus necessary to handle 300 ft. would be so large that it was decided to use a 50-ft. piece. The current was supplied by an 18-kw. 1000-amp. transformer, which allowed only an 18-volt drop in the cable. Under no condition would this transformer handle 300 ft. of cable when armored.

The effective resistance of No. 4/0 armored cable is shown in Table X. Table IV shows that for the No. 6 armored cable there is an increase of effective resistance with an increase of current throughout the tests. The No. 4/0 cable did not show this constant increase. With 25-cycle current, there is a constant decrease; with 60 cycles and lead sheath open circuited, there was a decrease, but with the lead sheath short-circuited there was an increase of resistance from 150 to 225 amp. and a decrease from 225 to 300 amp. Further tests were made with the 60-cycle current from 20 amp. to 300 amp. with the results plotted as shown in Fig. I.

Short-circuiting the steel tape does not alter materially the shape of the curve, but short-circuiting the lead sheath changes the shape considerably. With the lead sheath open circuited there is a rapid rise of effective resistance with current up to about 50 amp.; beyond that point there is a correspondingly rapid decrease to about 90 amp., when the rate of decrease becomes smaller. Saturation curves of the steel tape (Fig. 2) show that the saturation point of the armor occurs at about 50 amp. As long as the magnetic flux increases uniformly with the current, there is an increase in the effective resistance, otherwise there is a decrease. The fact might be mentioned here that the tests on the No. 6 armored cable were all made with such small currents that the saturation point was not reached. This would account for the constant increase of the effective resistance.

DIMENSIONS OF NO. 4/0 ARMORED CABLE

Length	50 ft.
Size of conductor (19 of 0.1055)	4/0 B. & S.
Wall of rubber insulation	5/64 in.
Diameter over insulation	22/32 in.
Diameter over lead sheath	55/64 in.
Diameter over outer steel tape	75/64 in.
Two 1-in. by 0.035-in. steel tapes	
Outside diameter over serves	43/32 in.

The saturation curve with lead sheath short-circuited is shown in Fig. 3. In this curve the point of saturation occurs at about 210 amp., which corresponds to the point of maximum effective resistance, as shown in Fig. 1.

Short-circuiting the lead sheath is similar to short-circuiting the secondary of a transformer, the iron being worked at a very low degree of saturation. Short-circuiting the steel tape increases the effective resistance when lead sheath is open, and decreases it when lead is short-circuited. With lead open, short-circuiting the steel tape has practically no effect upon the lead, but does set up secondary currents in the steel. This accounts for the greater effective resistance with a short-circuited steel tape and lead sheath open, as shown in Fig. 1, curves *A-B*. When the lead sheath is short-circuited, short-circuiting the steel tape causes a de-

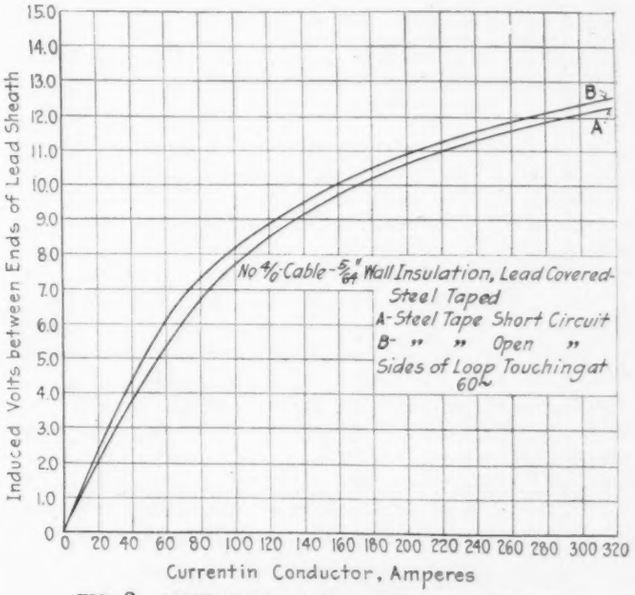

No 4/0 Cable-5/64" Wall Insulation, Lead Covered-Steel Taped
A-Steel Tape Short Circuit
B- " " Open "
Sides of Loop Touching at 60~
Induced Volts between Ends of Lead Sheath
Current in Conductor, Amperes
B
A

FIG. 2—SATURATION CURVE WITH LEAD SHEATH OPEN CIRCUITED

crease in the secondary currents of the lead, causing a decrease in effective resistance of the cable, as shown in Fig. 1, *C-D*.

The values of the secondary currents in lead sheath and steel tape are shown in Table XI. The secondary currents in the lead sheath increase considerably with distance of separation for the unarmored cable, but for the armored cable the increase is very small. This is due to the fact that in the latter case, the magnetic flux is so strong that altering the distance of separation can have but little effect upon the flux linking the cable.

Table VIII shows that there is an increase in effective resistance with an increase of distance of separation, regardless of the condition of secondary circuits. With the armored cable this is so for the 25-cycle current, but with the 60-cycle current there is an increase when the lead sheath is open circuited, and a decrease when the lead sheath is short-circuited, as shown in Table X.

The same general relations hold between current and impedance, distance of separation and impedance, as in the case of the effective resistance as shown in Table XII, but the conditions for maximum effective resistance are the conditions for minimum impedance and vice versa. The maximum effective resistance depends in a large part on the currents in the secondary circuits. When these currents are large, as when the lead and steel tapes are short-circuited, the effective resistance of the cable must be large, but these secondary currents cause a low degree of saturation of the iron and thus a low resistance of the cable (Table (XIII).

The hysteresis loop of the steel tape used on armored cables is shown in Fig. 4. Calculations show that during the tests on the No. 4/0 the values of *H* were from ten to forty-five, while for the No. 6 cable the values of *H* were less than ten. The results of these tests indicate that it is not possible to give any simple formula

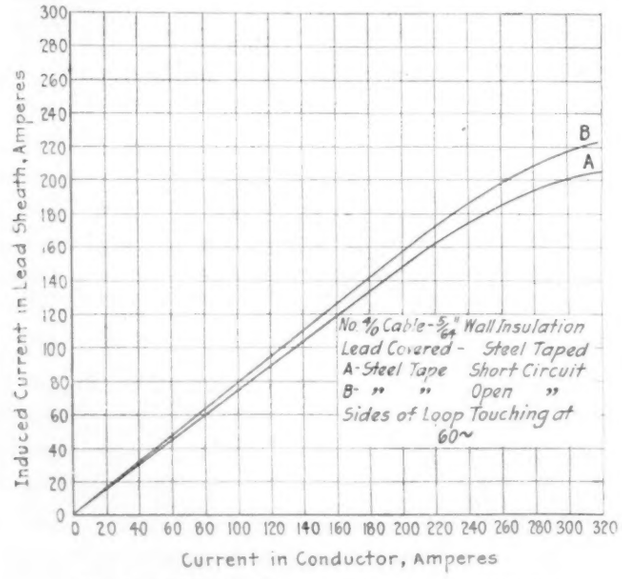

Induced Current in Lead Sheath, Amperes
Current in Conductor, Amperes
No 4/0 Cable-5/64" Wall Insulation
Lead Covered - Steel Taped
A-Steel Tape Short Circuit
B- " " Open "
Sides of Loop Touching at 60~
A
B

FIG. 3—SATURATION CURVE WITH LEAD SHEATH SHORT-CIRCUITED

by which the losses in this type of cable can be calculated. Among the variables that must be considered in any calculation on the steel-taped cable are the permeability, the saturation point of the steel, the width of the air gap between successive turns of the tape, and the temperature rise of the cable.

SUMMARY OF RESULTS

The losses in the No. 6 solid lead covered and steel taped armored cable are not large when used for small currents (6 or 7 amp.), as in series lighting circuits. The advantages gained by the use of this cable more than offset the small voltage drop and power loss.

The electrical constants of this class of cable cannot be determined by simple calculation, owing to the variation in permeability and degree of saturation in the iron armor.

The results show the losses on the No. 4/0 cable are larger than the losses on the No. 6 cable for the same

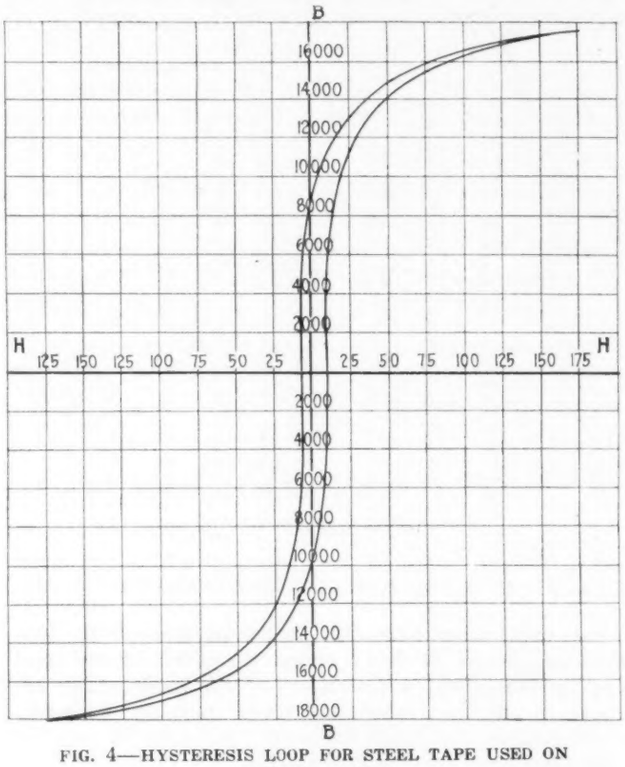


FIG. 4—HYSTERESIS LOOP FOR STEEL TAPE USED ON ARMORED CABLE

current, which is contrary to what should be expected. The flux around the cable should vary inversely as the radius of the cable, and the losses should vary as some power of the flux.

Distance of separation between the sides of the circuit has very little effect upon the secondary of the iron-armored cable, the magnetic circuit is of such low reluctance, but with the unarmored cable the increase is considerable.

The secondary currents in this type of cable are so large that the carrying capacity is greatly reduced due to heating. Where cables have to be used at or about their normal carrying capacity, the single conductor iron-armored cable should not be used on alternating-current circuits.

Wireless Telephonic Communication Between Generating Stations

The drainage board, Sanitary District of Chicago, has authorized an expenditure not to exceed $4,000 for the installation of wireless telephones at the generating station at Lockport and the receiving station in Chicago. The energy from Lockport is transmitted to Chicago, 32 miles distant, over a twin-circuit transmission line of steel towers at 44,000 volts. At certain seasons of the year lightning is extremely severe, putting the telephone system out of commission. It is to overcome this difficulty, namely to permit communication between the two stations when most needed, that wireless telephones are to be installed.

STATION AND OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Time Required to Trim Magnetite Arc Lamps

At a recent hearing before the Massachusetts Gas and Electric Light Commission in the Boston Edison Company's street lighting rate case, L. L. Elden, electrical superintendent of the company, gave the results of a test to determine the time required to trim 6.6-amp. magnetite arc lamps on typical Boston circuits. Observations which were carried over an entire day showed that the average time required at the lamp was one minute and forty-four seconds, with the average time spent in traveling between lamps two minutes and ten seconds. Trimmer and observer traveled by horse-drawn team, and a route of 14.4 miles of circuit was covered. It was found that the number of lamps per circuit did not greatly affect the traveling time or the time spent between lamps. In doing the trimming, the employee climbed the pole, the globes being suspended by hangers usually from 23 to 25 ft. above the street. He then brushed the chimney, replaced the lower electrode, brushed out the inside of the lamp, dusted out the globe, replaced it, latched it and descended. The lamp was cut out of service while working upon it.

On account of these details and the difficulties of lamp trimming, it has been found almost impossible for one man to trim an average of over 100 lamps per day. A maximum of 110 has been attained on a congested route, but these high rates cannot be maintained. Two men are always assigned to routes where the number of lamps runs from 110 to 130. Probably two or more times as many lamps can be trimmed per day per man on commercial interior lighting service, on account of the closer spacing of units and other favorable conditions. There are, however, no commercial magnetite lamps in use in Boston interiors.

Head-Gate Opening and Forebay-Level Indicators

The crest of the canal between the pond and forebay of the Falls Village hydroelectric plant of the Connecticut Power Company had to be built about 9 ft. below the pond level. As a result it is necessary to carefully regulate the opening of headworks gates with fluctuations in turbine loads so that no water will be wasted over the canal spillway. For this purpose some ingenious signaling devices are used—one indicating the amount the headgates are moved, and the other whether the canal level is too low or too high.

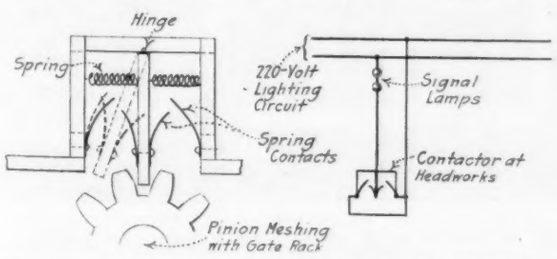


FIG. 1—CONSTRUCTION AND ELECTRICAL CONNECTIONS OF HEAD-GATE MOVEMENT INDICATOR

As shown by the accompanying drawing the gate-movement indicator consists of a pivoted strip of wood carrying two connected spring contacts and held in a perpendicular position by springs. The lower end of this wooden strip engages with one of the pinions meshing with the gate rack. Attached to a wooden frame on each side of the pivoted lever are other spring contacts which are connected together electrically. These are joined with one terminal of a lamp in the generating station down stream, the other lamp terminal being connected with the lighting circuit. The movable contact on the gate-movement indicator is connected with the other conductor of the lighting circuit. Thus when the gate is raised or lowered, which is done by means of remote controlled induction motors, the movable contact makes connection with one or the other stationary contact and lights the signal lamp at the station as many times as there are teeth that pass the lever. Since the pitch of the gate rack is about 2 in., it is simple to determine the movement of the gates by multiplying the number of times the lamp lights by two. In making up the records, the amount the gates are raised or lowered is added to or subtracted from the previous gate-opening reading. From previous records of total turbine load pond elevation and gate opening the operator is able to judge how much the gates should be moved.

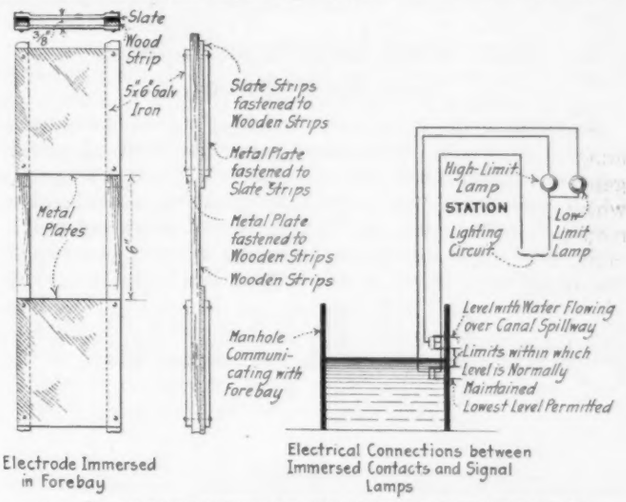


FIG. 2—ARRANGEMENT OF ELECTRODES IN FOREBAY TO INDICATE LEVEL

In order that the operator will be warned automatically when more water has to be supplied to the canal to maintain a certain forebay level, and also when the gates have to be adjusted to prevent water wasting over the canal spillway, contacts are arranged as shown herewith in the forebay. They consist of two pairs of iron plates clamped between wooden strips and installed in the forebay so the lower edges of the lower plates are at the lowest elevation at which the forebay should be maintained. The upper edges of the upper plates are at the maximum elevation that the forebay can be maintained at without wasting water over the spillway. Between each pair of plates are insulating separators

that hold the plates about 0.375 in. apart. One plate of each set is connected with one side of the signal-lamp circuit while the other two plates are connected with two signal lamps. The remaining terminals of the lamps are connected with the other side of the circuit.

Thus when the forebay level is correct the lower plates in the forebay are completely immersed so that the lower-limit signal lamp burns brightly. If not enough water is being supplied to the canal the forebay level drops, causing the lower-limit lamp to dim or even go out, which is a sign that the canal intake gates have to be opened. The amount which they shall be opened, as mentioned before, is based on previous records for similar loads. If the load becomes so light that the forebay level rises, then the upper-limit lamp begins to glow, getting brighter as the canal level approaches the point where water will pass over the canal spillway. While this scheme is employed on a system where the conditions are different from those on most systems, the signaling method is applicable almost anywhere. Both methods were devised by J. K. Mackie, superintendent of the Housatonic division of the Connecticut Power Company.

How Condenser-Tube Expense Can Be Reduced

A method of mending condenser tubes has been adopted by F. M. Wilbraham, superintendent of power generation Hartford (Conn.) Electric Light Company, which has saved the company investing considerable money in new tubes. In fact, in twelve years not much more than $500 worth of tubes have been purchased for 58,000 sq. ft. of condensers. With the price of

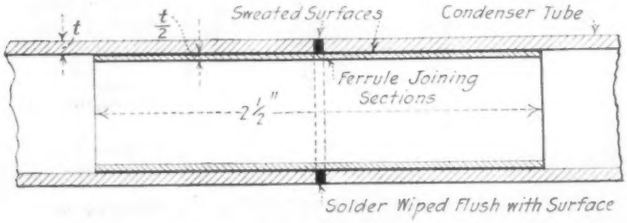


FIG. 1—METHOD OF SPLICING CONDENSER TUBES

tubes at the present high mark this method should be of interest to all station operators.

In brief, the scheme consists in cutting out the section containing the break and inserting a new one, which is joined with the other sections by an inner sleeve or ferrule about 2.5 in. long. The latter consists of a piece of tubing about half as thick as the condenser tube and has a diameter that will make it fit tightly in the sections to be joined. Both the ferrule and the ends of the sections to be joined are thoroughly tinned, and after being assembled are sweated together. In making these joints special care is taken to cut the ends square so they will meet and make a practically continuous tube. Any solder that may adhere to the outside of the joint is wiped off or removed with emery cloth so that the tube can be inserted in the tube plates in the regular manner. Usually several ferrules are prepared and tinned in advance so there will not be much delay in making repairs.

While as many as four such joints have been made in one tube, Mr. Wilbraham does not advocate using more than this number, since they may reduce the condensing ability of the tube. This method is employed principally for repairing breaks that occur near the tube plates due to expansion and contraction, but may also be used to repair ripped tubes. When the latter is done, however, care must be taken to cut far enough on each side of the rupture so that no weakened metal is left.

A Scheme that Prevents Flashes in Junction Boxes

The clearance between cable terminals in Tailleur underground cable junction boxes is small, and when work is being done on any terminal connected to a cable which may be grounded, it is a very easy matter to get a short-circuit between this and the adjacent terminals which might cause considerable trouble. While the voltage is only 220, the cables are not fused at the substation in the Commonwealth Edison Company (Chicago) system, and hence the capacity of the entire system is behind whatever short-circuit may occur and the resulting flash may be severe.

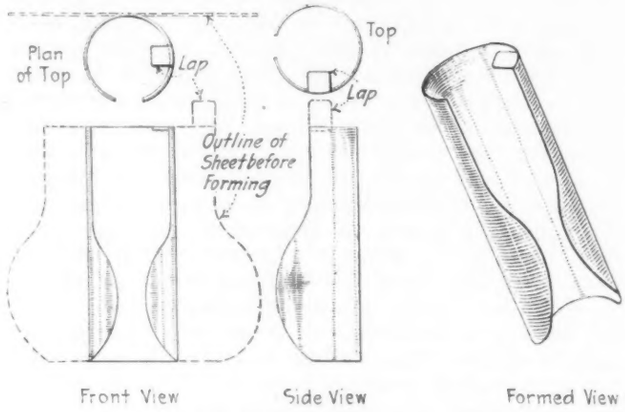


FIG. 1—CONSTRUCTION OF A FIBER CABLE-TERMINAL SHIELD

Protection against this danger is being used by the Chicago company in the form of specially shaped fiber shields, which are placed on the two terminals adjacent to the one to be worked on. These are cut and formed to have a lip at the top which slips over the top of the terminal. As the bottom of the shield is pushed into position, the sides are sprung out and finally clip over the round portion of the terminal, the elasticity of the fiber holding the shield firmly in place. To remove the shield the top is pulled out and, as in putting on, the curved edge of the shield, by virtue of which it laps

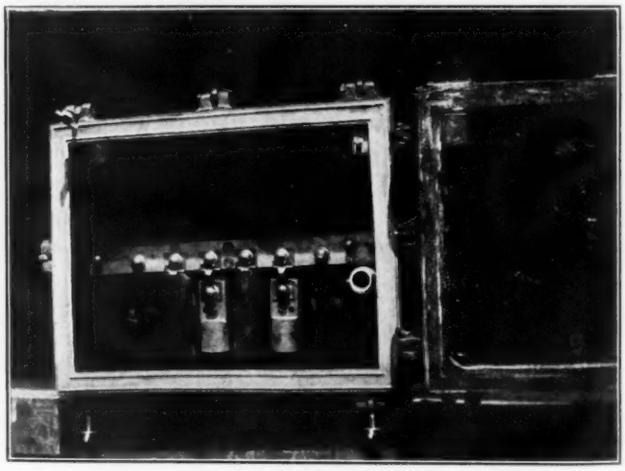


FIG. 2—METHOD OF USING CABLE-TERMINAL SHIELD

further around the terminal toward the bottom, forces the edges apart as it is pulled off and the shield slips off easily. When working on the back one of the two buses in the junction box, shields are placed over the front one. These are also formed from fiber and made up in pairs, the two pieces telescoping together so that all of the bus or only a portion may be covered, depending on the work to be done.

Installation Data for Underfeed Stokers

According to recommendations of the Sanford Riley Stoker Company, the following relations may be employed when determining upon the lay-out of underfeed boiler plants and selecting the auxiliary equipment to be used:

Horsepower required to drive stokers, ½ hp. per retort; rate of coal feed, 12 to 15 lb. per stroke per retort; air required for combustion, 225 cu. ft. per pound of combustible; duct area required, 1 sq. ft. per retort; air velocity in ducts, 2000 to 3000 ft. per minute.

When the stokers are filled with coal (250 lb. per retort) the weight is distributed about as follows: On the base plate I-beams, 2000 lb. per retort; on supports under the front wall, 2500 lb. per retort; on supports under stoker front angle, 500 lb. per retort.

Distributing Turbine Loads for Best Water Rate

While it may seem at first thought that the highest steam turbine economy will be obtained when each unit is operated at its most efficient load, this is not always found true in practice, according to W. A. Hirt of the Detroit Edison Company. For instance, in some tests made by this company it was found that nine turbine-driven sets considered separately operated most economically at the following loads:

TABLE I—MOST ECONOMICAL LOADS FOR MACHINES TESTED

Unit Number	Turbine, Kw.	Generator, Kva.	Best Point, Kw.
1	8,000	8,890	6,500
2	8,000	8,890	5,750
3	8,000	8,890	5,000
6	14,000	14,000	7,000
7	14,000	14,000	8,300
8	14,000	14,000	7,500
9	15,000	18,750	11,500

These conditions existed with certain steam and condensing water temperatures, so that any change in conditions would affect the relations mentioned. When the water rate of the turbines as a whole was considered, however, it was found that the better economy could be obtained by operating the turbines at other than their individual most efficient loads. This is shown by the following results obtained with three different divisions of load:

TABLE II—EFFECT ON TOTAL WATER RATE OF CHANGING INDIVIDUAL LOADS

No.	Load	Water	Load	Water	Load	Water
1	8,800	117,000	9,000	120,000	9,000	120,000
2	8,600	116,000	8,000	108,000	8,000	108,000
3	5,500	75,000	5,500	75,000	6,100	84,000
4	5,800	78,500	6,000	81,500	5,600	76,000
6	7,100	100,000	6,500	92,000	6,000	85,000
7	8,900	121,000	9,700	132,800	10,000	137,500
8	8,000	110,000	8,500	117,000	9,000	124,000
9	14,000	181,000	13,500	174,200	13,000	167,700
Total	66,700	898,500	66,700	900,500	66,700	902,200

While more efficient results might be obtained by some other distribution of loads, the three tests given indicate that a considerable saving can be obtained by manipulating the combination. For instance, with the same units and the same load, water rates of 902,200, 900,500 and 898,500 can be obtained by different load distributions. Taking the extreme figures, it can be seen that 3700 lb. of water per hour could be saved, or under the conditions at the Detroit Edison plant approximately 400 lb. of coal could be saved per hour.

Protecting Manhole Cables Against Explosions of Those Adjacent

BY ALBERT F. HOVEY

In one of the oldest and perhaps best known of the methods for fireproofing cables in manholes against the explosion of adjacent cables, common rope and concrete are employed. The former is wound spirally around the cable with about 1 in. separation between the turns, and the cable and rope are then plastered with a one to one mixture of sand and cement. The rope provides a rough surface to which the concrete clings readily and gives a slightly flexible background, which aids somewhat in preventing cracking of the fireproofing under a chance blow.

The workmen's hands have proved to be better than any tool for applying the cement for this type of covering. As far as the fireproofing qualities alone are concerned, this covering is satisfactory, but its removal presents a formidable task. Efforts to reduce this difficulty have been made by placing the turns of rope closer together and, except for the fact that rope is now rather expensive, this method of protecting cable is fairly satisfactory.

Another method of fireproofing is that in which asbestos millboard, cut into 3-in. strips, is wound around the cable and held in place by a fireproof paste, silicate of soda. This covering proved satisfactory as long as the manholes remained dry, but if water ran in and covered the cables, the silicate was dissolved and the asbestos loosened, dropping from the cable. Recently, on account of the difficulty in obtaining deliveries of asbestos millboard, asbestos listing, a woven material with a selvage has been substituted. This material can be purchased in the form of 3-in. tape and wound spirally around the cable, and the silicate of soda covering is used to hold it in place.

When material as expensive as asbestos is used for fireproofing cables, some provision should be made for selvaging the covering when it is removed from the cable. A simple and inexpensive way of doing this is first to wrap the lead sheath of the cable with strips of cheesecloth dipped in paraffine. One layer of cheesecloth is sufficient. Then when repairs are necessary, the asbestos can be separated easily from the paraffined cloth and taken off in long strips. If these strips of asbestos are carefully rolled backward during removal, they can be preserved and reapplied.

In what is perhaps the most recent method of fireproofing underground cables, a layer of paraffined cheesecloth is wound around the sheath and over this metal lath, covered with cement and cut into strips, is spirally wound. The cloth is applied as described above, simply to aid in removing the covering. The metal lath used is a wire mesh covered with brick, clay, put on under pressure and baked, the resultant product being a web of small briquettes which can be applied the same as any wire or expanded metal lath. This makes an excellent foundation for the cement mortar, as it is porous and flexible. The cement can be applied with a trowel or by hand, forming the covering into a homogeneous mass. While this type of covering is somewhat more difficult to install than the asbestos covering, it is considerably less expensive, as calculated from the prevailing prices of material. It can easily be removed by breaking the cement covering with a hammer and cutting the metal lath with tinner's snips.

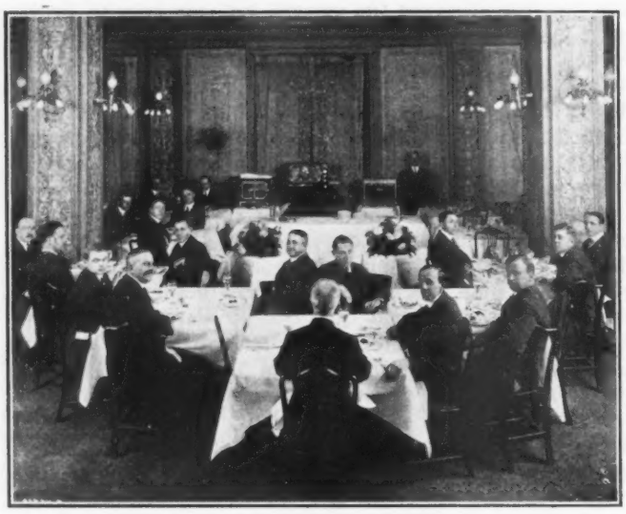
Whatever covering is applied should be considered good insurance against both mechanical and electrical trouble. The added application of paraffined cheesecloth under any of these types of covering insures the lead sheath against damage at the time the covering is removed for changes in the manhole cables.

COMMERCIAL AND BUSINESS POLICY

A Department of Plans and Methods for Widening the Application of Electricity and for Extending Electric Service

Architects and Contractors Entertained at Electrically Cooked Dinner

To demonstrate the merits of cooking by wire to those who are interested in the up-to-date design of buildings, R. A. MacGregor, sales manager of the Mer-



INDIANAPOLIS ARCHITECTS AND ELECTRICAL CONTRACTORS GUESTS OF MERCHANTS HEAT & LIGHT COMPANY AT ELECTRICALLY COOKED DINNER

chants Heat & Light Company, Indianapolis, Ind., entertained twenty-five of the leading architects and contractors of the city at an electrically cooked dinner. One of the novel ideas worked out at the dinner was cleverly set forth in a newspaper comment on the meeting. This story read as follows:

"When is an old hen not an old hen? According to Roy A. MacGregor, sales manager of the Merchants Heat & Light Company, the answer is: 'When it's cooked with electricity.' Mr. MacGregor was host at an 'electrical dinner' for a number of architects, apartment-house builders and real estate men, the purpose being to prove that cooking with electricity is convenient and economical. Old hens were chosen purposely, to show that tougher and inferior meats can be made juicy and tender by the electrical process. Baked fish, potatoes au gratin, peas, mashed potatoes, biscuits, mince pie and coffee completed the meal, which was cooked in the dining room of the hotel within sight of the guests. Dinner for twenty-five persons was cooked with less than 19 cents' worth of electricity."

In commenting upon the meeting, Mr. MacGregor remarked: "There is little need to say that this novel stunt met with the approval of all present and has started our range work on a real going basis. Through our efforts over 150 ranges have been ordered for apartment houses within the last sixty days, and at present as many more are under consideration. Since the dinner proved that electric cooking can be conducted in the dining room of a prominent hotel without the odors of the cooking disturbing other guests, a great point was registered in favor of the installation of electric ranges in apartment houses."

The Time for a "Drive" on Power Business

"The price of coal is going up. Power rates of central stations are either going down or remain fixed. The power costs in isolated plant operation are, therefore, increasing, when they could be reduced—or at least held stationary—by abolishing the use of coal and adopting central station power."

The foregoing argument is now being advanced on every hand by the general manager of a large central station in the Mississippi Valley. On the expense charts of his own company—a combination water-power and steam-power concern—he has recently seen the price of coal increase until the actual increase is greater in dollars and cents than the former total cost of coal. With this knowledge of his own conditions he is sure isolated plant owners must be discussing ways and means of reducing power costs. He is therefore taking advantage of their state of mind to place before them the advantages of his product. His success in this endeavor has led him to suggest the adoption of a similar policy by his fellow central station men.

Flood-Lighting the Springfield (Mass.) Municipal Group

In connection with the recent National Dairy Show at Springfield, Mass., the buildings of the celebrated "Municipal Group" on Court Square were illuminated by flood-lights, as indicated in the accompanying view of the tower taken from the western shore of the Connecticut River. The main buildings were lighted by six curb Type "C" lamps of 1000-watts, 20-amp. rating, mounted about 50 ft. in front of the façades. The top of the tower was illuminated by twelve 500-watt L-1 and two 1000-watt General Electric L-2 projectors. Three L-1 and one M-2 projectors were located on the Springfield Institution for Savings, 500 ft. from the front of the group, and the remaining projectors were on the group buildings themselves at a distance of about 150 ft. from the campanile. William E. Hodge,

ILLUMINATION OF THE SPRINGFIELD MUNICIPAL BUILDINGS AS VIEWED FROM A POINT HALF A MILE AWAY

deputy superintendent of street lighting, has informed a representative of the ELECTRICAL WORLD that a permanent installation is now being tentatively planned along the above lines, slightly modified according to experience gained at the time of the Dairy Show. The 500-watt L-1 projectors used were furnished by the United Electric Light Company of Springfield.

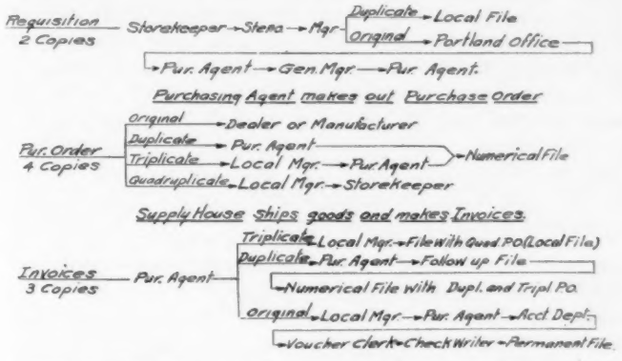
REQUISITIONS, AS THE PURCHASING AGENT SEES THEM

Some Suggestions on Issuing Orders for Supplies Which Will Effect Economies and Reduce Operating Costs

BY C. H. STILL

Purchasing Agent, Pacific Power & Light Company, Portland, Ore.

By a requisition is meant a formal request that certain materials or supplies be furnished an individual, department or branch. The person issuing a requisition on the purchasing agent does not always consider the fact that he is actually calling for an expenditure of money. Nor does he realize that the wasting or saving of a considerable sum depends almost entirely upon the manner in which he issues his requisitions.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ROUTE OF REQUISITION IN THE PACIFIC POWER & LIGHT COMPANY'S ORGANIZATION, FROM KEEPER TO GENERAL FILE

The chart shown merely outlines the work that is started with the issue of a requisition, in the organization of the Pacific Power & Light Company, and does not show in detail the number of times requisitions, purchase orders and invoices are handled and rehandled.

HOW TIME AND MONEY CAN BE SAVED

If a man lives out in the country he does not go to town every time he wants to buy a single article, he makes a note of it and when he has a list sufficiently large to warrant he makes the trip, getting all of the articles at one time.

This plan, obviously, should be adopted by everyone issuing requisitions. When the stock of a certain article is getting low, instead of immediately sending in a requisition for it, a memorandum should be kept of such articles, to be included in the next requisition. Then when a requisition is being prepared to forward to the purchasing agent, the stock of active supplies should be gone over carefully and everything included that will be needed within a specified length of time.

This will enable the purchasing agent to buy to better advantage by ordering larger quantities and also will result in a saving in transportation charges, etc.

If requisitions were to be sent in from each of the twenty storerooms of the Pacific Power & Light Company every time a single item or article was desired, it would mean that the purchasing agent might receive a requisition every day for a small quantity of similar supplies from each of the storerooms.

TO CITE AN EXAMPLE

As the supplies called for are generally ordered the day the requisition is received, if it is properly made out and the purchase approved, the loss occasioned by requisitions being received in this way would be considerable.

For instance, a requisition might be received one day for, say, one hundred ⅜-in. galvanized tees, the next day another for some bushings, on the following day for some reducers and on the fourth day for a few hundred feet of pipe.

The purchasing agent would not know that such requisitions were to be received in succession, and if the buying is being handled promptly, as it should be, he would issue four purchase orders, one each day, which would mean that four separate shipments would be made, each of the first three being subject to a minimum freight and cartage charge of at least 40 cents.

If the storekeeper had anticipated his requirements only three days all the items would have been included in one requisition, only one purchase order would have been issued and one shipment made, resulting in a saving of not less than $1 in freight and cartage charges, as well as $1.50 in stationery, postage and routine work incident to the issuance of the three extra purchase orders.

Of course, the ledger cost of the material would only be affected by the freight and cartage charges of not less than $1 in the instance cited, but the total cost to the company due to requisitions being issued in such a careless manner would be not less than $2.50.

REQUISITIONS SHOULD BE CORRECTLY MADE OUT

Requisitions that are improperly made out are also sources of expense and cause delay in furnishing supplies necessitating more or less correspondence before the purchase order can be placed.

Requisitions for general supplies should be forwarded to the purchasing department at stated intervals of one or two weeks, while those for stationery and office supplies should be issued monthly.

They should show the quantity on hand and the quantity desired, as well as a complete description of articles wanted.

Of course there are occasions where supplies are required, in cases of emergency, that cannot be anticipated. In such cases requisitions can be mailed in at any time, or if necessary, telephoned or telegraphed to the purchasing agent and confirmed by mail.

These examples illustrate, however, the bearing a requisition has on the cost of supplies as well as on operating costs.

Checking Charging Plug Connections

BY R. L. HERVEY

When connecting up a charging plug for an electric automobile, the operator must be very careful to see that the polarity of the plug is correct. Automobile manufacturers using the V or delta-shaped plug have adopted the standard connection of having the positive terminal of the battery to the right when facing the socket. All mercury rectifiers and most charging panels have the d.c. terminals marked + and —. With these marks and knowing the polarity of the socket, the next step is to test the plug and cable. This can be easily done by holding one plate of the plug on a cell terminal and brushing the free ends of the cable across the other terminal of the same cell. A momentary short-circuit can not hurt the cell.

The Manager and the Training of Company Employees

"Progress in any industry cannot move faster than the ability of the employees to carry on the production, sales and accounting activities with loyalty in their hearts, with co-operation in their methods, and with judgment and intelligence in their work," observed Dr. Lee Galloway, chairman of the educational committee of the National Commercial Gas Association in addressing its convention at Atlantic City this week. "None of these essentials," continued Dr. Galloway, "was ever introduced into an organization by indifference, egotism or ignorance.

"Loyalty will come only as a result of worthy motives; co-operation will come only as a result of broad-minded policies; judgment and intelligence will come only as a result of constant and continuous watchfulness over the kind of information assembled for the employees' benefit, and the methods of imparting this knowledge to them.

"There is no greater fallacy in the minds of most employees to-day than that promotion, position and salary have no necessary connection with ability, integrity, industry and business training. This misunderstanding is due to ignorance of the true relationship of these qualities to success, and naturally the employees place the blame for their own slow progress upon their superiors, rather than to refer it to themselves. It may be true that the exceptional employee can reach the top of the ladder if he works hard enough to master the details of his job, and in addition learn the bearings of the company's policies. Such men soon discover how much there is to learn, and that everything depends upon themselves, but it is equally true that the great majority of men are kept from real exertion because they do not know the real nature of their work. They have never gone into the problems of their positions, and hence do not realize how much there is to learn before real responsibility can be put upon their shoulders. They, therefore, believe that the man who succeeds does so because he is lucky, or is shown favoritism. They are unable to distinguish between the requirements of the skilled and the unskilled job. They have never known the real nature of skilled employment.

Teach Employees to Think

"There is no royal road to enthusiasm, co-operation and loyalty, for all of these lie through the highway of knowledge and training. The first duty of every manager is, therefore, not to prepare ginger talks but to post signs cautioning men to *think*. A misunderstanding of the true source of sales inspiration has led many managers astray. They have worn themselves out keying their salesmen up for the work of the day or the week, in pumping them full of enthusiasm, in figuring out prize quotas and bonus rewards to keep their men loyal, only to find that their sales forces were as weak at the end of the year as at the beginning, and that the whole thing must be done over again for the new year with, perhaps, a new set of men.

"Managers may talk and talk in vain in attempting to get ignorant men enthusiastic about their work, or in trying to instill a spirit of co-operation and loyalty. These things do not come for the asking. Enthusiasm does not come from the outside; co-operation is not born from compulsion; loyalty is not gained by indiscriminate bestowal of rewards. Enthusiasm, co-operation and loyalty are developed only from the inside, and are fed only through the proper tissues and by the proper methods of assimilation.

"It would be quite as sensible for a manager to exhort his men to be fat or lean as to command them to be enthusiastic and loyal, without feeding them the proper food and giving it time to be assimilated. Enthusiasm cannot be put into a man's spirit any more directly than salts can be put into his blood. Hypodermic injections may pull a patient through a crisis; a ginger talk may carry a salesman through a day's selling campaign, but the enthusiasm that is to carry a salesman through the whole year, and keep him cheerful day after day when reproofs are frequent and business hard to pull, can come only through the proper assimilation of information and knowledge pertaining to his job, which, turning first into confidence, and then into enthusiasm, builds within his tissues a storage battery of sales energy and loyalty for his firm."

Central-Station Emblem Combining Lighting and Power

The attractive central-station emblem lately adopted by the Hartford (Conn.) Electric Light Company, illustrates virtually in monogram form the company's ability to supply both lighting and power service. The trademark of the company consists of a circular band carrying the initials of the organization and the word "Service," the band being broken at the top to carry the neck and base of a gas-filled lamp formed by the gap and space inside the ring. An electric motor of modern design occupies the center of the emblem. Badges with this emblem are worn by employees, and copies of it are printed on the company's stationery and featured at exhibitions by transparencies and signs. The trademark is also used on price tags in the company's appliance exchange. It will be noted that besides the customary information these tags give the cost of operating the device by the hour, and the terms of any guarantee that accompanies the appliance.

APPLIANCE TAGS SHOWING HARTFORD COMPANY'S NEW EMBLEM. NOTE ALSO SPACE FOR INDICATING COST OF OPERATING THE APPLIANCE BY THE HOUR

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SINGLE-PHASE POWER SERVICE

The Role of the Phase Converter in Correcting the Unbalancing Effect of Large Single-Phase Loads on a Polyphase System

AMONG the interesting and important papers on single-phase service presented at the recent Philadelphia meeting of the American Institute of Electrical Engineers (see ELECTRICAL WORLD, Oct. 21, page 800), the paper by E. F. W. Alexanderson and G. H. Hill is noteworthy since it deals in a concise manner with the operation of the "phase converter" wherever in large polyphase systems considerable amounts of single-phase power are required, and it is necessary to correct the unbalancing effect of the single-phase load. The use of the phase converter greatly extends the possibility of connecting single-phase loads directly to a polyphase system provided the frequency does not have to be changed.

All methods of phase conversion necessarily involve the storage of energy. While storage of energy in inductances and condensers is very convenient for high-frequency currents, yet for phase conversion of low-frequency power current on a large scale only one type of apparatus is to be considered, that is, a rotating machine which stores the energy in the mechanical inertia of the rotor.

The phase converter may be considered from three different viewpoints, the first being as a motor-generator. The phase converter is built as a quarter-phase induction motor or synchronous motor with a squirrel cage; one phase is a motor phase and the other phase is a generator phase. The input of the motor phase is equal to the output from the generator phase and in fact identical with it, with the only difference that the momentary values of current, volts and energy are delayed 0.25 cycle in one winding in relation to the other. The squirrel cage is the medium for the transfer of energy, and the mechanical mass of the rotor provides the energy storage.

But what causes the phase difference of 0.25 cycle between the energy flow in the two phases? Evidently whatever means are provided, the result of these means must be the desired flow of currents through the windings, and therefore the means must consist in providing the necessary electromotive forces to cause these currents to flow through the windings. One method of providing these emfs. is to use an auxiliary generator which impresses the desired emf. on the windings, or a transformer or an induction regulator. This method is used in the phase balancer sets recently installed by the Philadelphia Electric Company. This type is the "shunt converter." Its function is to transfer energy from one phase to another in a polyphase system so as to neutralize the effect of single-phase load drawn from the same system in another place. Another method is to connect the windings of the converter with reference to the source of power and the load in such a way that the emfs. are furnished automatically by the source of power. This leads to the Alexanderson series converter. The single-phase circuit is in series with one phase of the converter. The function of the series converter is not to correct for a single-phase load that has been placed on a polyphase line but to change the single-phase load into a polyphase load before it is connected to the line.

Secondly, the phase converter may be considered as a polyphase generator. A single-phase current may be mathematically resolved into two polyphase components with opposite phase rotation. One of these polyphase components has the same phase rotation as the power system and constitutes a legitimate load on the power system. The other component, which has the opposite phase rotation, is the one which causes the unbalancing of voltage. This component must be neutralized by the phase converter. Hence the phase converter must feed into the system a polyphase current which has opposite phase rotation to the system and is equal and opposite to the component of the single-phase load to be neutralized. Hence the converter should be a polyphase

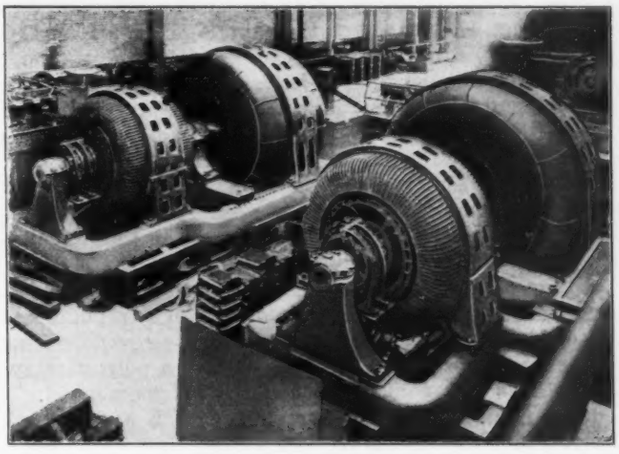


FIG. 1—PHASE-BALANCER SETS

machine, preferably synchronous, and means are to be provided for forcing a current to flow through the windings of the phase machine which has opposite phase rotation to the system. This current is to be regulated in magnitude and phase corresponding to the single-phase load. One convenient way is to provide a polyphase generator with its field controlled by suitable regulators. These considerations have led to the design of the shunt converter with direct connected balancer and regulators such as used by the Philadelphia Electric Company (Fig. 1). The sets consist of a main converter and an auxiliary balancing machine which is controlled by automatic regulators. The main converter is mechanically connected to a generator which is called a balancer. The function of this balancer is to circulate polyphase currents of the desired phase and magnitude in the windings of the converter. This auxiliary generator is small compared to the converter because its output is used only to overcome the losses and inductive drop in the windings of the main converter.

Thirdly, the phase converter may be considered as a transformer. The two stator windings of the phase converter represent the primary and secondary of a transformer. The squirrel cage rotor is a medium for

transferring the current from the primary to the secondary and the characteristics of the phase converter as a transformer differs from the ordinay transformer only by the fact that the time phase of the secondary is 0.25 cycle from the time phase of the primary. This displacement of time phase is due to the time required for the squirrel cage to rotate through the angle corresponding to the location of the primary and secondary windings of the stator. The analogy between the phase converter and a transformer may be driven pretty far, as is interestingly shown in the original paper. The impedance of the converter when considered as a transformer is the same as the stationary impedance of the same machine measured as an induction motor at standstill.

In regard to efficiency and size, the phase converter can be considered as being in the same class as the synchronous condenser. In fact it has substantially the same structure, the difference being that the squirrel cage which is usually employed in the synchronous condensers to counteract hunting becomes in the phase converter the main rotor winding, while the field winding of the synchronous condenser is reduced to a small winding sufficient to carry no-load excitation. Due to the similarity in structure the same machine can act as a synchronous condenser and phase converter at the same time if the windings are proportioned for this purpose.

The shunt converter is of particular value in those cases when it is expected that single-phase load may be drawn from different phases of a polyphase system. In such cases unbalancing of the single-phase load will be partly neutralized and it will be necessary to convert only the difference between the single-phase loads. There are, on the other hand, cases where the series phase converter can be used to best advantage. Those are cases when it is desired to convert the single-phase load at the point where it is connected to the polyphase system. The series converter has in that case the advantage of simplicity, as the arrangement is automatic and no auxiliary generator or voltage regulator is needed. In cases where a single electric welding machine or arc furnace is to be fed from a polyphase system, the series converter should be recommended. If such an installation has been made with a series converter in order to insure the lowest first cost, and it should be desired to add other furnaces to the other phases, the same converter might be used as a shunt converter without any increase of converter capacity but with the addition of suitable regulating devices.

Generators, Motors and Transformers

Parallel Operation of Frequency-Changer Sets.—F. D. NEWBURY.—The parallel operation of frequency-changer sets, consisting of a synchronous motor of one frequency driving a synchronous generator of another frequency, requires that both the motors and the generators shall respectively be in synchronism. The methods of mechanically adjusting and synchronizing frequency-changer sets of this kind are described and notes are added on starting and stopping such sets.—*Elec. Jour.*, November, 1916.

Lamps and Lighting

Emissive Power of Tungsten for Short Wave Lengths.—E. O. HULBERT.—A brief account of an investigation carried out at the Nela Research Laboratories on the variations in the emission power of tungsten between wave lengths 3200 and 5500 angstr. for true temperatures 1746 to 2785 deg. abs. The chief results are given in a table. The change in the emissive power with temperature was determined by drawing the "isochromes," *i.e.*, the curves for a constant wave length showing the relation between the logarithm of the energy emitted and the reciprocal of the temperature. The isochromes were found to be straight lines within the error of experiment. Calculations based on the determinations of the slopes of these lines showed that the emissive power increased as the temperature decreased for all the wave lengths under investigation. The data further indicated that the rate of increase of emissive power with decrease of temperature became greater as the wave length became shorter.—*Journal Franklin Inst.*, November, 1916.

Generation, Transmission and Distribution

Electric Power Supply on the Northeast Coast of England.—R. P. SLOAN.—A paper read before Section G of the British Association. There is now a uniform system of power supply on the northeast coast of England, with an area of 1400 square miles. The distance between the northern and southern extremities of the transmission system is 70 miles, and it is now possible to obtain electricity on the same system as regards frequency and voltage throughout practically the whole of the area. The main transmission and distribution system is a three-phase system with a frequency of 40 cycles per second, and the working pressure is 20,000 volts. The capacity of plant installed represents about one-ninth of that in public supply stations in the United Kingdom, but as the northeast coast power companies are working at a more constant load—*i.e.*, a better "load factor"—the electricity actually generated is about one-fifth. The total horsepower at present being supplied is 343,000. The supply of electricity for traction and to coal mines is discussed. One of the most interesting features of the problem that had to be dealt with was the utilization of the waste heat in the district. The counties of Northumberland and Durham and the North Riding of Yorkshire produce some 7,500,000 tons of coke per annum, and the retort type of coke oven has made rapid progress. The waste heat from these ovens and from the blast furnaces and the exhaust steam from blowing engines in the Cleveland district form a considerable source of power. The problem of the utilization of this waste heat has been solved by the establishment of local generating stations, where such surplus power is available. These plants feed into the main power companies' system, and the stations work in parallel with the five main generating stations of the power companies. The power company need install no spare plant in any of the waste heat stations connected to its system, being able to meet any variation of load by means of its coal-fired stations, which also act as standby against any breakdown. Moreover, the power company, having a market for current many times greater than the output of any individual waste-heat station, is able to run such stations continuously at their maximum output capacity, so utilizing completely all the current that can be produced therein, whereas it is impossible to conceive the power requirement of an individual coke-oven and colliery installation coinciding even approximately over twenty-four hours with the amount of gas or waste heat available. There are now eleven waste-heat stations in operation in the northeast coast area, and the waste heat available is sufficient for the generation of an amount of power very considerably in excess of that required by the colliery owners. During the year 1915 two of these stations alone turned out 40,000,000 kw.-hr., of which only 10,000,000, or 25 per cent, was required for the working of the collieries, the remaining 30,000,000 being delivered into the mains of the power supply company. The total coal saving due to utilization of waste heat

in the northeast coast now amounts to some 150,000 tons per annum.—London *Electrician*, Sept. 22, 1916.

Installations, Systems and Appliances

Electricity in Small Households.—W. B. SMITH.—A paper illustrated by diagrams read before the Greenock Electrical Society. The author gives a diagram showing for conditions in Great Britain the annual cost of lighting and installations for houses of from two to eight apartments, wired in steel tubing and wood casing respectively, also a diagram of the annual electric light bills for various sizes of houses and another diagram showing the variation of the bills from month to month.

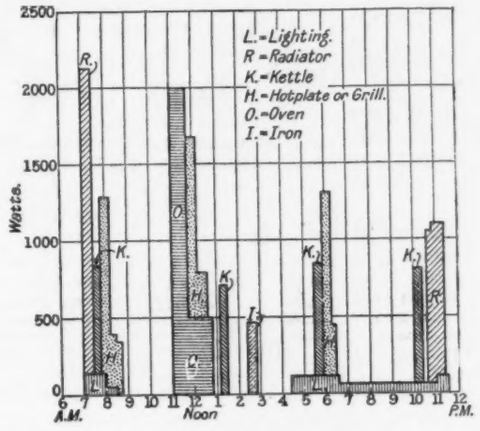


FIG. 2—DAILY LOAD DEMAND (DURING WINTER) FOR SMALL DWELLING HOUSE

He then takes up the discussion of "small-current" domestic appliances and gives a diagram of the annual fixed charge for different sizes of houses. The recent boom in electric heating in England is undoubtedly due to the advent of a reliable electric "fire" giving radiant as well as convected heat. In actual heating value, electricity is seriously handicapped when placed alongside coal and gas. From each unit of electric energy only 3419 B.t.u. can be produced, so that at 1.5 cents per kilowatt-hour 2 cents' worth of electricity gives 4.550 B.t.u.; 2 cents' worth of gas at 72 cents per 1000 cu. ft has a heat value of about four times this amount; while for coal at $6.25 per ton the same cost would yield 105,000 heat units, or more than twenty times the number of B.t.u. But the excellent efficiency of electricity for heating enables it to compete in point of cost with gas at least, and although more costly than heating by coal fire, its other advantages would certainly recommend it in preference to the coal fire. It is estimated that about 1.5 watts per cubic foot is necessary for the electric heating to raise the temperature by about 12 deg. Fahr. in one hour; but half of this expenditure of energy suffices to maintain that degree of heat. In a room 14 ft. by 12 ft. by 10 ft. in size, the capacity of the heater required would be 2.5 kw., which could be reduced to about 1 kw. after the first few hours. Electric cooking is next discussed. In a small household of three persons where the cooking is done by electricity, and where electric heaters are used for occasional heating of rooms, the diagram in Fig. 2 would apply for a winter day. In this case, the lighting consumption is 0.6 kw.-hr. per day, costing 3.6 cents per day at 6 cents per kilowatt-hour. The consumption for heating and cooking is 4.5 kw.-hrs. per day, costing 6.75 cents at 1.5 cents per kilowatt-hour. For a day in summer the cost would obviously be much less. In this case the daily load factor for lighting works out at 3 per cent, while with the cooking and supplementary heating, the load factor is raised to 10 per cent for the same house. The average price paid for the whole supply works out at a little more than 2 cents per kilowatt-hour.—London *Electrician*, Oct. 20, 1916.

Miscellaneous

Self-Luminous Paint.—W. S. ANDREWS.—Certain fluorescent and phosphorescent and mineral compounds, especially zinc sulphide, are so sensitive to radioactivity that they show luminescence when brought near radium. Crookes' spinthariscope (Fig. 3) is based on this fact. This device consists of a little dark chamber inclosing a disk of cardboard that is coated with zinc sulphide. A small wire is fixed above the disk so that one end of it is very close to the sulphide but not touching it and a microscopic speck of a salt of radium is attached to this end of the wire. When this combination is observed through a magnifying lens of proper power, the zinc sulphide is seen to be perpetually scintillating with innumerable little stars in the vicinity of the radium. This appearance is caused by the alpha rays that are discharged from the radium with tremendous velocity, some of which bombard the sulphide like atomic cannon balls, every hit producing a flash of light on the target. By mixing a very minute amount of a radium salt with finely-powdered zinc sulphide and a suitable adhesive a luminous paint is obtained. It is used on the hands and dials of watches and clocks, on the pointers of aeroplane compasses, on electric switch boxes, etc. It should not be confounded with the older Balmain's luminous paint, the base of which is a special preparation of phosphorescent calcium sulphide, and which requires the excitation of a strong light to make it shine. It absorbs the luminous radiation and then emits it again as a soft phosphorescent glow which gradually fades away, so that in the course of a few hours it ceases to be visible until again excited to phosphorescence. The self-luminous radioactive paint differs entirely from the above in containing within itself its own exciting power, so that it continues to shine indefinitely even when kept in perpetual darkness. Radium has a "half period" decay of 1750 years, hence the radium in the paint is everlasting for all practical purposes, but the amount of luminous quality locked up in the zinc sulphide is exhausted in time. By increasing the ratio of radium salt to zinc sulphide in the paint, the luminescence is increased, but

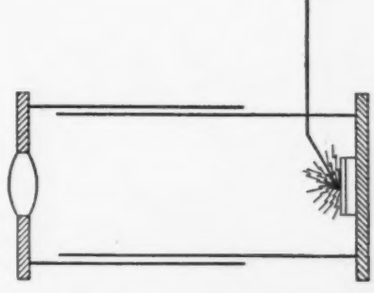


FIG. 3—DIAGRAM OF THE SPINTHARISCOPE

the useful life is reduced. For army and navy purposes the United States government calls for a guarantee on self-luminous paint that it shall maintain an undiminished luminosity for two years. Thorium is also radioactive and may be used together with radium in the paint. Meso-thorium, from which radio-thorium is evolved, is a by-product of the incandescent gas mantle industry and on account of its relative cheapness as compared with radium it is now being used extensively either by itself or combined with radium in the production of self-luminous paints.—*Gen. Elec. Rev.*, September, 1916.

G. Douglas Jones, who has been electrical engineer of the California State Department of Engineering for the past six years, has tendered his resignation.

Hjalmar Hertz, president of the Diehl Manufacturing Company of Elizabeth, N. J., has been appointed by President R. K. Sheppard of the Associated Manufacturers of Electrical Supplies as the representative of the association in the Chamber of Commerce of the United States.

E. H. Jacobs has been appointed chief engineer for the Electrical Engineers Equipment Company of Chicago. Mr. Jacobs is a graduate of the University of Michigan and had seventeen years' experience with the General Electric Company at Schenectady, N. Y., as designing engineer of station control apparatus.

Edward Hammett has resigned as vice-president and general manager of the Sheboygan (Wis.) Electric Company to become associated with a group including August Westermeyer, who was formerly auditor of the company, in the purchase of the plant of the Northern Furniture Company of Sheboygan. Before coming to Sheboygan Mr. Hammett was connected with the Electric Supply Company of Pittsburgh. He is a native of Wheaton, Ill., and was graduated from Northwestern University, Chicago. He has been connected with the Sheboygan Electric Company for the last seven years, first as superintendent of railways and later as general manager. Following the recent purchase of the company by the Kelsey-Brewer Company of Grand Rapids Mich., Mr. Hammett was appointed vice-president and general manager.

J. C. Causland, the president-elect of the Association of Railway Electrical Engineers, received his early experience in the electrical industry in the employ of a small central station, the Grand Ridge (Ill.) Electric Light & Power Company. After nearly two years' service with this company he became connected with the Pennsylvania Railroad in 1895. During his twenty years of service for this railroad he has risen to the position of chief electrical engineer of the Chicago Terminal Division.

J. C. CAUSLAND

Men of the Industry

Changes in Personnel and Position— Biographical Notes

Samuel M. Heffner of Providence, R. I., has been appointed manager of the Meredith (N. H.) Electric Light Company.

Ralph G. Macy, superintendent of the East Side municipal electric plant in Norwalk, Conn., has handed in his resignation to take effect Jan. 1.

C. D. Montieth has been appointed commercial manager of the Missoula (Mont.) Light & Water Company to succeed Hugh M. Ferguson, recently resigned.

Day Baker, who has been prominent in electric-vehicle promotion activity in New England, has resigned as New England representative for the General Vehicle Company.

Walter H. Monroe, former manager of the Port Arthur (Tex.) Light & Power Company, has been appointed manager of the Paris plant of the Texas Light & Power Company.

P. H. Bailey, who has been commercial manager of the Harrisburg (Pa.) Light & Power Company, has resigned to accept a position as sales manager for the Moorhead Knitting Company of Harrisburg, Pa.

Hugh M. Ferguson, manager of the commercial department and steam-heating business of the Missoula (Mont.) Light & Water Company, has resigned to accept a position with the Utah Power & Light Company of Salt Lake City, Utah, where he will have charge of the steam-heating business.

Glenn Wilson, for the last seven years in charge of the specialty department of the Cutler-Hammer Manufacturing Company in the East, has resigned to accept a position with the Franklin Electric Manufacturing Company, Hartford, Conn., manufacturers of incandescent lamps. Mr. Wilson will represent the Franklin company in western New York State, with headquarters at Buffalo.

Obituary

John M. Connelly, advertising manager of the Denver Gas & Electric Light Company and well known as a newspaper man and central-station exponent, died on Oct. 31, at the age of forty-two years. Mr. Connelly entered the service of the Denver Gas & Electric Light Company in 1903 in the publicity department, and was from that time forward closely identified with the work of building up the big public service company. Mr. Connelly had long been in ill health, but a series of relapses, increasingly frequent during the last five years, never robbed him of his cheerfulness nor prevented him from being always at the service of his friends. Mr. Connelly was buried on Nov. 3. The members of the Dartmouth Alumni Association, the University Club, the Denver Advertising Club and the employees of the Denver Gas & Electric Light Company attended the services in a body. Many of Denver's prominent men were also present. The offices of the Denver Gas & Electric Light Company were closed between 12 and 1 o'clock on Friday as a tribute to Mr. Connelly.

Edward West Hammer, a widely known electrical engineer and one of the founders of the Cutler-Hammer Company of Milwaukee, died at Cleveland, Ohio, on Nov. 7, after an illness of only three weeks. For the past two years Mr. Hammer had been manager of the business-efficiency department of the National Lamp Works at Nela Park, Cleveland, which he had instituted. Mr. Hammer was born on July 25, 1867, near Des Moines, Iowa, and was educated in electrical and civil engineering at Iowa State College, Ames, Iowa. His earliest connection with the electrical business was with the street railway company at Des Moines, where he afterward became general superintendent. About twenty-five years ago, with Harry Cutler, Mr. Hammer organized the Cutler-Hammer Company, which quickly reached a position of manufacturing importance. Mr. Hammer's business activities were surprisingly varied. He had owned and operated a hotel in Chicago, had managed factories, and was president of the General Engineering & Construction Company, Chicago, which installed automatic telephone systems in Chicago, Lincoln, Neb.; Butte, Mont., and other places in the West and Middle West. About five years ago he served as consulting engineer for an electric traction project in Salt Lake City, Utah. Mr. Hammer's business success was due largely to his exceptional faculty for handling, analyzing and retaining facts and figures, and in drawing accurate conclusions from them. He had a most kindly and sympathetic nature, and his untimely death will be felt as a personal loss by hundreds of his former associates.

E. W. HAMMER

NEW APPARATUS AND APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Meter Testing Blocks

To simplify the installing, changing and testing of watt-hour meters, which are used in combination with current transformers or with current and potential transformers, the States Company, 19 New Park Avenue, Hartford, Conn., offers a new type of connection and test blocks. The test block is arranged with a row of insulated thumbscrews which are normally screwed down to complete the connections between the line and the meter. When the thumbscrews, which are in the circuit with the current transformer leads, are unscrewed, the transformers are automatically short-circuited. By further unscrewing the same thumbscrews, the current element of the meter becomes disconnected from the transformer.

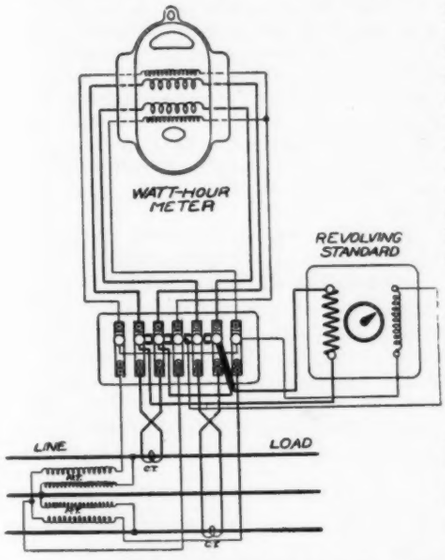


FIG. 1—USING TESTING JACK AND CONSUMER'S LOAD

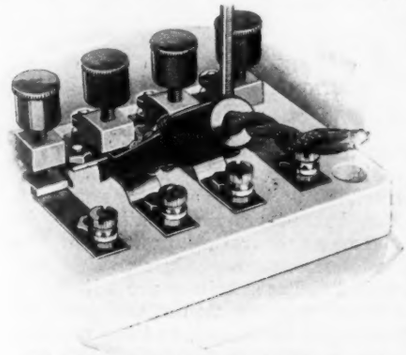


FIG. 2—TESTING JACK INSERTED IN METER-TESTING BLOCK

The test blocks have a porcelain base and a metal cover fastened by wing nuts. A disconnecting terminal to facilitate the connecting of standard and load is used when testing with artificial or phantom load. A test jack shown in use (Fig. 2) is also provided so that a standard instrument may be connected to the customer's load without interrupting service. It is stated that when this jack is inserted as shown the current will be automatically shunted to the standard without any possibility of opening the circuit or otherwise causing trouble. The test block may also be used for testing polyphase meters. Fig. 1 illustrates the using of the testing jack and consumer's load, with the current elements in series and shunts in multiple.

Improvements in Street Lighting Fixtures

An arrangement for fastening reflectors to porcelain bodies of streethoods has been developed by the George Cutter Company of South Bend, Ind. The fixtures shown in the accompanying illustrations, it is claimed, are suitable for either multiple or high-voltage series systems. The streethood consists of an iron canopy, porcelain body, socket and reflector. The porcelain body is ventilated, providing a free circulation of cool air at the socket and lamp terminals when the type "C" gas-filled lamp is used. For series circuits, film sockets must be provided with a cut-out film which will not be susceptible to this great heat. When a lamp goes out it is absolutely essential that the cut-out films puncture at a uniform voltage, thus preventing the damaging lamp-destroying surge which occurs at the moment before the circuit is re-established.

FIG. 1—REGENT FILM SOCKET

To prevent rust and corrosion when enameled steel reflectors are chipped, this company covers its reflectors with a very tough, wear-resisting coating of green enamel for the top surface and a correspondingly tough white reflecting surface. This combination has proven to be a great improvement over a more brittle coating. To prevent chipping at the heel where it is fastened to the porcelain body, a copper heel is burnished over the inner edge of the enamel heel and the binding screws set into this.

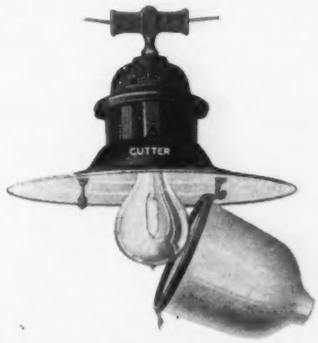


FIG. 2—HINGED HOLDER FASTENED TO REFLECTOR

Snow and sleet are kept from collecting on the top of the reflector by a bowl type of design called the "Radial Bowl." This not only furnishes better drainage, it is claimed, but also provides a far better distribution of light for both old-style series and the new-style nitrogen-filled lamp. As shown in Fig. 2, a hinged holder may be fastened to the reflector so that the strain caused by the additional weight of the globe or reflector will not have an injurious effect. Streethoods of this type may be suspended from an ornamental bracket attached to a pole, or may swing over the center of the street from a strand suspension, to which they are fastened with a cable clamp. The Boulevard telescope bracket shown in Fig. 3 is typical of those which can be used for

FIG. 3—BOULEVARD TELESCOPE BRACKET

the bracket type of suspension. This bracket is made in 5-ft. lengths, and can be extended to 7 ft. It is also made in other sizes as required.

Portable D'Arsonval Galvanometer

The Leeds & Northrup Company, 4901 Stenton Avenue, Philadelphia, has brought out a portable D'Arsonval galvanometer with a sensitivity such that 1 volt through a resistance of 1 megohm will cause a deflection of one scale division. The scale divisions are 1 millimeter wide. The resistance of the galvanometer is about 225 ohms and the period 2.5 sec. The instrument is partially damped on open circuit. It is arranged to be very satisfactorily damped

PORTABLE GALVANOMETER WITH SUSPENDED MOVEMENT

when used with ordinary Wheatstone Bridge combinations, and is critically damped on an external resistance of about 200 ohms. The galvanometer system is of the suspended type mounted in a box 3 in. wide, 5 in. long and 3 in. deep. The magnet is permanently fastened to the under side of the top of the box, which is of specially selected steel. The moving system is contained in a separate unit which can be easily removed from the box for examination or repair. Two screws secure the system casing to the box and at the same time complete the connections between the binding posts and the galvanometer. The coil is rectangular in shape. The suspensions are single strands of phosphor bronze strip and are fastened at their outer ends to springs. These springs take up the strain which would otherwise exist in the suspensions when the instrument is subjected to jars. The suspensions are thus protected against breakage except in cases of excessive jars. The top covering contains a glass-covered aperture through which the pointer and scale are viewed, and also an adjusting screw for bringing the pointer to zero.

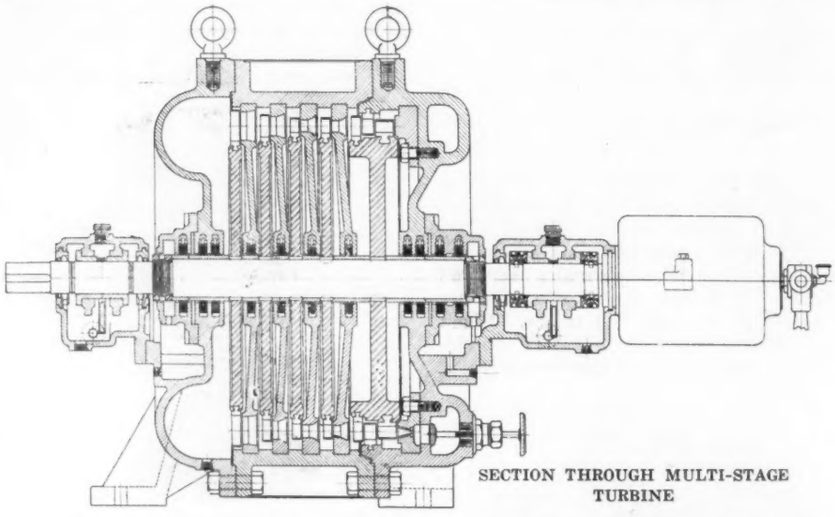
Single and Multi-Stage Steam Turbines

Steam turbines in sizes from 1 to 5000 hp. are now being made by the Moore Steam Turbine Corporation of Wellsville, N. Y. The single-stage unit built by this company consists of a single velocity stage made up of a set of diverging expanding nozzles and a wheel carrying two rows of moving blades, with a set of stationary reversing vanes following the first row of moving blades. The multi-stage unit consists of the same single velocity stage used in the single-stage turbine, followed by two or more single-pressure stages. Each of these single stages consists of a set of nozzles and a wheel. A feature obtained by the use of a velocity stage for the first stage is on account of the comparatively large drop in pressure in the first stage it is much less difficult to effectively pack the shaft against leakage at the high-pressure end of the turbine. Non-condensing turbines in small sizes are usually of the single velocity stage type, while the larger sizes are of the three or five-stage or multi-stage type. Condensing turbines up to 500 hp. are built as five or seven-stage machines and a larger number of stages are used for 500 to 1000-hp. machines.

The turbine casings are in all instances split horizontally so that the upper half can be removed, exposing the rotor for inspection or removal. The diaphragms are also divided horizontally, and the two halves attached permanently to the upper and lower halves of the casing, so that when the upper half casing is lifting the upper half diaphragm comes with it, leaving the rotor removable. The diaphragm halves are held in the casing by a set of special tapered screwed plugs inserted in the vertical joint while the diaphragm and casing are held rigidly in a fixture specially designed for this purpose.

The rotor consists of a single velocity stage wheel carrying two rows of moving buckets, followed by two or more single-pressure stage wheels, all mounted on the same shaft. The wheels and shaft are of steel, and the first stage wheel is of built up, or solid forged construction. The single-pressure stage wheels are machined from solid steel plates. The buckets are of steel drawn or machined perfectly smooth, and set into a dovetailed groove in the periphery of the wheel. The buckets can be easily removed when it is necessary to renew them. Liberal clearances over the buckets are used (about 0.5 in.) and liberal endwise clearances, also, with the further provision that the side of the wheel and not the buckets will rub, should the rotor become displaced in an endwise direction. The nozzles on the first stage are made of bronze and are of the diverging, expanding type cast and finished accurately to size and then recast into a cast-iron ring which is attached to the steam end casting. The nozzles of the second and following stages are formed by casting sheet-metal strips into the diaphragms. These nozzles are broached out to the exact size required. This method of manufacture, it is claimed, results in a perfectly smooth and highly efficient nozzle.

Reversing vanes are used between the two rows of moving buckets of the first-stage wheel. These are set into a bored dovetailed groove in the steam end casting, and held securely in place by suitable attachments. The bearings are of suitable type for high-speed service, and are provided with ring or forced lubrications, or both, depending upon the size of turbine and operating conditions. There is no appreciable thrust, it is declared, in the turbine rotor, but in order to maintain it in the correct operating position in the smaller size, thrust collars of steel are provided. These collars are adjustable so the endwise position of the rotor can be changed if desired, and the running clearance between the collars and the ends of the bearing can be altered to take up wear. In the larger sizes the Kingsbury thrust bearing is used. This bearing consists of small blocks faced with babbitt and pivoted so the blocks will have a uniform bearing. This bearing is easily lubricated and will stand heavy pressures if necessary without heating.



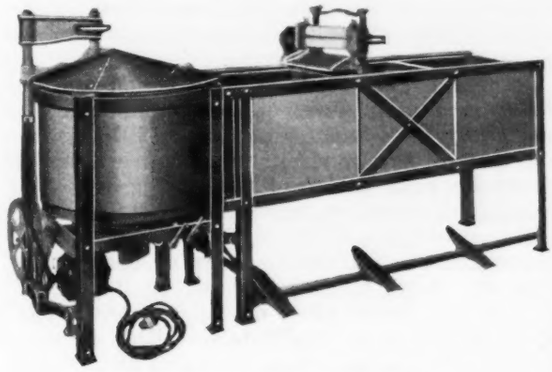
SECTION THROUGH MULTI-STAGE TURBINE

The governor used is of the direct-connected type, mounted on the end of the turbine shaft, and actuates a steam-regulating valve through a lever connection. Where extremely close regulation is required, as in the case of generator units, the makers recommend an oil relay governor, which is highly sensitive and specially designed for close regulation. A Jahns governor is used to actuate the oil relay control. In this governor the weights are so arranged that the spring pressure comes directly against the weight and the pressure exerted by the weights does not enter as a factor in the friction of any of the moving parts. The governor-regulating valve is of the double-heat balanced poppet type, provided with ground mitred seats.

An overspeed governor is provided which is entirely independent of the main governor, and which, should the speed of the turbine exceed a certain predetermined amount, trips a valve placed in the main steam connection.

Washing Machine for Permanent Installation

Every operation in washing from heating the water to wringing the clothes can be accomplished with the Thermo-electric vacuum washer which is being manufactured by Smith & Phillips Manufacturing Company, 412 Sangamon Street, Chicago, Ill. The



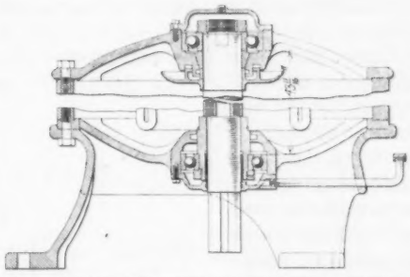
THERMO-ELECTRIC VACUUM WASHER

washing machine proper is unusual in that the tub is revolved on its axis once in two minutes by a motor-driven ratchet, while the vacuum cup in the tub moves up and down at the rate of sixty strokes per minute. Thus clothes in all parts of the tub are brought under the action of the vacuum cup. By a simple adjustment the capacity of the tub can be varied from two to twenty sheets. A gas burner is placed beneath the tub to maintain the water at any desired temperature.

From the washing machine the clothes can be passed through a wringer operated by the same motor that washes the clothes into the adjacent tub. Then the wringer, which slides on a track, can again be used to wring clothes from the second to the third tub and from the third tub to a basket. To insure safety the wringer is controlled by foot pedals. The washer with three tubs occupies a floor space 24 in. wide by 86 in. long. The apparatus is designed for installation as a unit with drain pipe, gas and electrical connections.

Electric Motor Equipment with Ball Bearings

A typical application of ball bearings to vertical motors made for the United States government by the Diehl Manufacturing Company is shown here.



BALL BEARINGS USED TO SUSTAIN THRUST AND RADIAL LOADS

These bearings are called "radio-thrust" by the maker, the Gurney Ball Bearing Company of Jamestown, N. Y., for the reason that they sustain heavy thrust and radial loads. In this case the bearing mounted on the upper end of the spindle takes both the radial and thrust loads while the lower bearing is of the radial type. The dirt and oil seal shown in the illustration is a design originated by the maker which has been adopted by the Diehl Manufacturing Company on the motors to which reference is made.

It is pointed out that the advantage offered by this type of bearing is that the desired degree of thrust capacity is realized with the minimum of diverting or curving the straight-away rolling of the balls, whereas it is pointed out with the ordinary thrust bearing a maximum of diverting or curving of the balls is involved.

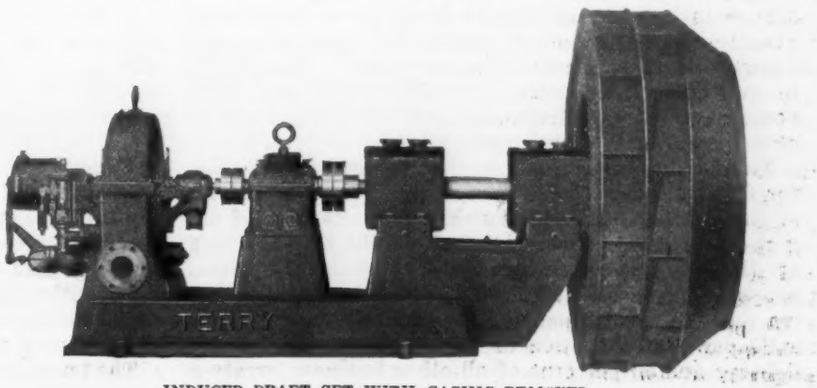
Feed-Through Switch

Another feed-through switch has been added to the line of such devices made by the Cutler-Hammer Manufacturing Company of Milwaukee. This switch is catalogued as No. 7050, and differs from Nos. 7040 and 7044, which are polished nickel brass shell types, in that molded insulating material (C-H Thermoplax) forms the body of the switch inclosing the push button operating mechanism. The switch is approved by the Underwriters' Laboratories for the same high rating as the brass shell type—6 amp., 125 volts; 3 amp. 250 volts. It may be located at any part of the cord used with electric appliances and eliminates wear on the socket, brings the control to the point desired by the user of the appliance and makes it unnecessary to pull out the plug to cut off the current.

Geared Turbine-Driven Fans

Operating simplicity and reliability make steam turbines specially suitable for boiler-room service; however, the relatively high speed has until recently prevented their being extensively used for driving induced draft fans, as such fans, on account of the large volumes handled, are usually of relatively slow speed. With the perfection and general adoption of high-speed reduction gears, turbine drive for induced draft fans is becoming more generally used and a considerable number of geared turbine-driven induced draft fans are now in operation. The accompanying illustration shows a typical unit with the fan housing removed. The turbine for this unit was built by the Terry Steam Turbine Company and the fan by the Green Fuel Economizer Company.

The turbines are of the Terry helical-flow type, in which the steam is passed repeatedly through a single row of moving buckets. This design, it is pointed out, permits the use of a wheel made from a single forging of special composition steel, with the buckets milled from the solid metal. The herringbone reduction gears for the unit illustrated have a ratio of 6.78:1 and the maximum speed of the pinion is 3630. On another type of units the maximum turbine speed is 4500 and the ratio is 3.7:1. The fans used in this service usually require from 25 to 50 hp., and give a 2-in. to 5-in. draft.



INDUCED DRAFT SET WITH CASING REMOVED

NEWS OF THE INDUSTRY

A Review of Activities in the Electrical Manufacturing, Selling and Central-Station Fields

LOS ANGELES SITUATION

Southern California Edison Company Applies to State Commission for Voidance of Valuation

The Southern California Edison Company has filed with the California Railroad Commission an application for the voiding of the valuation recently placed upon its Los Angeles distribution system. The sixty days in which the city could use this valuation as a basis in the condemnation suit against the company in the Superior Court has elapsed without suit being filed.

At the present time negotiations between the city and the three local power companies are in progress, but in a passive state, and competitive conditions prevail in the northeast part of the city, a small residence district. The city has cut in its service, using power obtained from the Pasadena municipal plant at a rate which the two municipalities are keeping secret from the public. It claims to have contracts covering 65 per cent of the business in this district, but revocations of the city's contracts have been signed by many residents. The city public service commission set a rate for this service which is 10 per cent under the rate of the companies and which must be confirmed by the City Council.

The latest step in the progress of negotiations is an announcement from Mayor F. T. Woodman that he is applying to the State Railroad Commission for further information. His application for further data follows the filing and analysis of the report presented by the special committee of engineers engaged by the city to analyze the propositions of the companies and the city previously evolved. This committee of engineers was comprised of C. W. Koiner, manager of Pasadena's municipal plant; J. D. Ross, manager of the Seattle municipal plant, and Prof. W. F. Durand of Stanford.

This committee presented a new plan, involving a $10,000,000 purchase price, and purchases of power by the city from the companies over a ten-year period, in amounts graduated from 50 per cent of the total requirement for the first two years to 10 per cent for the last year, at 0.85 cents per kilowatt-hour. The objection of the companies to this plan is its use of a valuation $2,279,000 under that corresponding to the commission valuation, and that the 0.85 cent rate for a 36 per cent load factor is below cost for power.

The companies have offered two alternative plans—first a cash payment for the distributing systems of $13,691,000 with a power contract of 1.41 cents per kilowatt-hour, or, second, the payment of $12,361,500 in installments, of which $3,651,500 should be a cash payment, the remainder to be distributed over a period of ten years at 6 per cent interest.

The Mayor, in applying to the Railroad Commission for further data, points out a weakness in the analysis of the benefits to the city which the committee of engineers estimated would result from the city carrying out the policy of paralleling the lines of the companies, and giving competitive service. They estimated that ten years of this competition would enable the city, with a 20 per cent reduction of rates, to obtain all street lighting and 50 per cent of all other business, create a property account of $10,000,000 in enlarged distribution system, and a cash balance of $7,327,000, at the same time saving the ratepayers $15,000,000 as compared with the present rates.

Mayor Woodman says: "Such a proposition is bound to cause economic waste. It means competition for years to come, which is a competition not good for the city or the city's future industrial growth, which will be retarded. This is a very vital feature. You must take the city's future into consideration."

RULES FOR SERVICE OF WASHINGTON UTILITIES

Meeting of Public Service Commission Called for Dec. 5 to Hear Arguments of Companies and Municipalities on Tentative Draft

After spending three days considering the tentative drafts of rules and regulations prescribing standards of service for electric, gas and water utilities, the Public Service Commission of Washington adjourned its conference until Dec. 5 at Seattle, when more tangible information will be obtainable. At this meeting representatives of electric power companies, telephone companies, municipalities and electrical workers of the State will meet with the commission, and after the evidence is heard there, it will be assembled and a formal hearing held in Olympia on Dec. 14.

An act relating to electrical construction and the maintenance and use of wires, apparatus and appliances was enacted by the State Legislature in 1913.

In the opening paragraph of the tentative draft for electric service rules the word "utility" is defined as "any corporation, company, association, joint stock association, partnership and person, their lessees, trustees or receivers, and every city or town owning, operating or managing any electric plant for hire within this State." Inasmuch as this would place municipal plants under the regulatory powers of the State the cities are making an attempt to exclude municipal plants and systems from the scope of this definition.

Another rule to which the municipalities object is one proposed by the private companies in regard to deposits, which reads in part as follows:

"Any utility may require from any customer or prospective customer a deposit on account of current bills (1) in the case of customers whose bills are payable in advance, not to exceed an estimated thirty days' bill; (2) in the case of customers whose bills are not payable in advance, not to exceed the estimated sixty days' bill of such customer; provided, that said utility may fix a minimum deposit in its tariff, not to exceed $5. Interest at the rate of 8 per cent per annum payable annually (or upon the returning of any deposit covering the time of the deposit) shall be paid by every company to its consumers upon every deposit so required, provided said deposit remains for a period of at least six months, and provided further, that interest shall cease at the same time that the consumption of the product used ceases."

The tentative rule drafted by the commission in regard to deposits was different in many respects. It required

customers to establish credit on one of three bases, (a) ownership of premises, (b) guarantor, (c) cash deposit.

The Electrical Workers' Union has also proposed some new rules and changes to certain of the rules contained in the act of 1913. The new rules proposed by the union are:

"1. No person or persons shall be permitted to work on live wires or cables carrying a voltage of 5000 volts or more.

"2. Each wooden pole or post used to support electrical conductors, span or guy wires, shall have a galvanized date nail showing the year pole was set driven flush with the surface of the pole at a distance of 12 ft. from the butt end, said nail to be made of about a No. 4 iron wire with a flat head about ⅝ in. in diameter, with depressed numerals ⅜ in. high stamped in before galvanizing, nail to be 2.5 in. long.

"3. Service wires to be defined as the span of wire between the last pole and the building or appliance to be furnished service.

"4. Wires or cables carrying more than 300 volts, having an insulating covering, dead ending on or supported by strain insulators or circuit breakers must have all live metal parts adjacent to poles, crossarms or similar fixtures covered with at least three layers of weather-proof tape or be otherwise equally well protected."

According to Section 3 of the Act of 1913 all wires, poles, electric fixtures and appliances of every kind and nature used or operated at the time of the passage of the act, must be changed and made to conform to the provisions of the act and the rules of the commission within five years from the date of its passage. This section is proving specially troublesome for the city of Seattle, as is borne out in the letter of the corporation counsel to the Seattle Council, in which it is stated:

"This means that before March 20, 1918, if this law and the rules of the Public Service Commission are to be complied with the lighting plant and overhead construction used in connection therewith must be materially changed. It was stated at the hearing before the Public Service Commission Nov. 1 by Mr. Dunbar, chief electrical engineer, that at the present time but 40 or 45 per cent of the overhead construction belonging to the city complies with the provisions of this law.

RECOMMENDATIONS FOR UTILITY VALUATION

Interstate Commerce Commission to Submit Outline of Method of Obtaining Fair Valuation for Guidance of State Bodies

Recommendations will be submitted by the Interstate Commerce Commission to Congress when it reconvenes which will outline for the guidance of state regulatory bodies the manner in which they should ascertain the fair valuation of utility companies. No attempt, it is declared, is to be made by the commission to suggest a federal law governing the matter, as public utility operations within a state are state matters and should be dealt with by state authorities.

While mainly designed to govern the principles of valuation as affecting railroads, the recommendations are said also to be directed to electric, gas and water companies which are operated generally within a state.

"Fair return," in the opinion of experts of the bureau of valuation of the Interstate Commerce Commission, is taken to mean that the amount of return should be such as to provide for the cost of economical and efficient operation, taxes, depreciation, a fair net return on the fair value of the property devoted to public use, and a proper margin for the successful conduct of the business. Exceptional efficiency of management, it is declared, should receive consideration by all determining boards.

It is declared that if state public service commissions adopt the recommendations of the Interstate Commerce Commission the method of ascertaining the fair value and fair returns of public service corporations will be uniform throughout the United States.

Public Service Commission News

Idaho Commission

The Idaho Power & Light Company has received permission from the Public Utilities Commission to refund to the municipalities of Glenns Ferry, Gooding, Jerome, Buhl, Wendell and American Falls within six months from and after Sept. 1, 1916, whatever difference there may be between the amount of the charges falling due to the power company under its schedule Q-2 for services supplied on and after Aug. 1, 1916, up to the date of the taking effect in such territory of schedule No. 4, or up to and until such later date or dates as the municipalities may respectively elect to take service under schedule No. 4 within the six months' limitation.

The refund is allowed for the reasons set forth in the order, which are as follows:

"Prior to Aug. 1, 1916, the street lighting service of the municipalities of Glenns Ferry, Gooding, Jerome, Buhl and Wendell, Idaho, was furnished by the Electric Investment Company, and the street lighting service of American Falls, Idaho, was furnished by the Southern Idaho Water Power Company, all of said service being furnished under ten-year contracts and in accordance with identical municipal incandescent street lighting schedules of said companies, the schedule of each company being designated as schedule Q-2;

"Applicant filed its schedule No. 4 of rates for municipal incandescent street lighting under tariff No. 5, which schedule heretofore has been applicable to all of its territory other than that specified by said schedule Q-2, said schedule 4 being effective from and after Sept. 1, 1916, and being applicable to all the territory served by applicant in the State of Idaho;

"While said Schedules Q-2 and No. 4 are not identical, schedule No. 4 contains substantially every advantage for the consumer that is contained in schedule Q-2, and, furthermore, it adds an opportunity for the consumer to obtain this type of service under ten-year contracts by making proportionately smaller annual payments than the payments which are specified in both schedules for this type of service when under contracts for a minimum term of seven and one-half years;

"That it is the desire of applicant to refund to such of the municipalities above named as shall make written election, within six months from and after when under contracts for a municipal street lighting service under said schedule No. 4, whatever difference there may be between the amount of the charges falling due to this petitioner under said schedule Q-2, for service supplied on and after Aug. 1, 1916, said date being the time when this petitioner succeeded to the interest of the said Electric Investment Company and the said Southern Idaho Water Power Company up to the date of taking effect in such territory of said schedule No. 4, or up to and until such later date or dates as said municipalities may respectively elect to take service under said schedule No. 4, within said six months' limitation, and the amount of those charges as they would have been if the same service had been rendered during the same period under the provision of said schedule No. 4."

New High Record for Wages Paid by New York Utilities.—The report of the New York State Department of Labor for the month of September last states that the water, light and power industry of the State employed 3 per cent more workers and paid out 6 per cent more wages than in August, establishing a new high record for wages. As compared with September, 1915, the group as a whole employed one-twentieth more workers and paid out one-seventh more wages.

Electrification of Wool Fibers.—The electrification of wool fibers is one of the problems in textile manufacture and considerable experimentation is being done on this score. Dr. S. A. Shorter, who is conducting the research on this problem at Leeds University, has discovered, according to the London *Electrical Review*, that the friction to which the fibers are subjected is not, as was supposed, the only cause of electrification of wool. It is also caused by drying, followed by lowering of the temperature. This discovery is one of the first results of the research instituted under the auspices of the Textile Institute.

Second Step Taken in Seattle Municipal Ownership Scheme.—A second step in the Seattle (Wash.) City Council's plan for the purchase of a completely developed hydroelectric plant, costing approximately $3,000,000, the condemnation of the Snoqualmie plant, and local distributing system of the Puget Sound Traction, Light & Power Company, and extension of the municipal lighting system, was taken on Nov. 6, when an ordinance was introduced providing for condemnation of lands on Lake Union, for an addition to the present steam auxiliary power plant. The additional unit proposed will double the present capacity of 7500 kw. of the steam plant, and the cost of the work is estimated at about $350,000. Funds for the land purchased will come from the balance of the $425,000 bonds authorized by voters on March 4, 1913. The details of the city's plans were explained in the ELECTRICAL WORLD for Nov. 11.

Large Turbine Demand By Doherty Properties.—Chief Engineer Milan R. Bump, at the Doherty organization executives' meeting on Nov. 9, gave an impressive recapitulation of the eminent demands for equipment among Doherty properties. This included a 12,500-kw. turbine for Denver, one of 5000 kw. for Ozark, one of 6250 kw. for Warren, in addition to the recent order of a 10,000-kw. unit. Moreover, Mansfield now insists that it must have a 5000-kw. turbine and another of 10,000 kw. instead of the two 5000-kw. units as originally planned. Salina wants 2000 kw. additional, and Bartlesville, Sedalia and Mt. Vernon have presented demands ranging from 750 to 1000 kw. Danbury has ideas along the same line, while Lincoln, Durham and Athens have equipment ordered this year. The Doherty organization will probably have to buy 100,000 kw. in turbine capacity, including the 40,000 kw. arranged for Toledo.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Harvard Business School to Study Local Utilities.—A course in the operation of local public utilities has been arranged for second-year men in the Graduate School of Business Administration, Harvard University. The course will be in charge of Mr. Blood, assisted by Mr. Stevens.

Chicago's Fires of Electrical Origin.—There were sixty-nine fires in Chicago during 1915 which could be traced to electrical sources. These fires caused a total loss of $13,315, an amount considerably smaller than the loss in 1914. Twenty-eight of these fires, or one-third of the total, were caused by electric flatirons, which through negligence, were left in service. The loss sustained in moving picture fires maintained the record of 1914.

Utility Companies Move Offices.—Recently a number of electric utility companies made arrangements for a change in the location of headquarters. The Twin State Gas & Electric Company, operating utilities in Vermont, New Hampshire and adjoining states, has moved its main office from Dover, N. H., to Brattleboro, Vt. The Public Service Company of Oklahoma has moved its headquarters from Oklahoma City to Tulsa. This company operates public utilities in a number of cities and villages in Oklahoma. Effective Nov. 20, the headquarters of the Kentucky Utilities Company will be moved from Lexington to Louisville, where the new offices will be in the Paul Jones Building.

President Exchanges Greetings by Wireless with Japan.—Greetings were exchanged on Wednesday between President Wilson and the Emperor of Japan, marking the inauguration of trans-Pacific wireless telegraphy by the Marconi Wireless Telegraph Company. The Marconi service between the United States and Hawaii has been in operation for over two years, and with the extension to Japan connection will be made with the Japanese Imperial Telegraph System to all points in the Orient. Messages will be sent from the high-power transmitting station at Bolinas, Cal., to the receiving station at Kahuku, Hawaii, whence they will be transmitted to Funabashi, Japan, where the high-power station of the Japanese Government is located. Messages from Japan will be relayed at Kahuku for the receiving station of the Marconi company at Marshall, Cal., which station has direct communication with the Western Union Telegraph Company, over whose wires the traffic will be forwarded. The link from Honolulu to Funabashi, 3355 miles, is the longest stretch over which commercial wireless has been sent.

Pennsylvania Labor Efficiency and Welfare Conference.—The Fourth Annual Welfare and Efficiency Conference, will be held in the hall of the Pennsylvania House of Representatives on Nov. 21, 22 and 23. This meeting is for the purpose of improving relations between employers and employees. It is intended also to develop further safe and sane methods of reducing the heavy toll of life and limb which is now taking place in Pennsylvania.

Copper Cost Hits Utility Valuation.—Testifying before the Public Utilities Commission of the District of Columbia a few days ago at the hearing on valuation of properties of the Potomac Electric Power Company, Charles L. Pillsbury, chief engineer of the valuation bureau, told how prices of copper and other metals have greatly increased since July 1, 1914. Valuations of the cost of reproduction of the properties are of that date. Mr. Pillsbury declined to estimate the extent of increase without reference to market reports. A statement, however, was made at the hearing that the increased cost of this item would add $1,500,000 to the valuation of the property made by Mr. Pillsbury.

Doherty Believes Every Engineer Should Have Selling Experience.—In speaking before the engineering cadets of the Toledo Railways & Light Company about the new business department end of the public utilities, Henry L. Doherty remarked: "I believe every engineer should have experience in actual business getting, in putting to work some of the ideas he has stored up in his brain through long years at college. You know generally we study too much and think too little. The man in the selling game has to think, think straight and think quickly, and I know of no better experience than to have a try at the actual selling of goods. If you make a marked success as a salesman there is hardly a job that you would afterwards tackle that you could not finish successfully on account of the experience you have gained in the field of salesmanship."

Managers of Texas Power & Light Company Hold Meeting at Dallas.—On Oct. 19, 20 and 21 the district managers and the resident engineers of the Texas Power & Light Company held a very interesting meeting at Dallas. The following papers were presented: "The Manager's Opportunity," F. R. Slater, vice-president and general manager; "Operation of Branch Towns," F. M. Wilkerson, manager Temple district; "Customers' Contracts," Hartwell Jalonick, commercial manager; "Safety," illustrated with lantern slides, J. H. Moseley, advertising manager; "Stores Accounting," F. L. Alig, material accountant; "Operating Costs," W. P. Murphy, manager Brownwood district. Besides these main papers a number of other subjects were discussed at "round-table" sessions devoted to operating and public policy matters. On Thursday evening, Oct. 19, all attending the meeting were present at a fellowship dinner at which J. F. Strickland, president of the company, was the principal speaker.

Convention on Daylight Saving Plan.—Plans have been laid for holding the daylight saving convention in New York City on Jan. 30 and 31.

Annual Convention Date of Ohio Engineering Society.—The thirty-eighth annual meeting of the Ohio Engineering Society will be held at Ohio State University, Columbus, Ohio, Jan. 31, Feb. 1 and 2, 1917. President Clyde T. Morris, professor of engineering at the university, has charge of the program.

Oregon Contractors Elect Officers.—The Oregon Electrical Contractors' Association recently elected officers as follows to serve for the ensuing term: President, F. C. Green; secretary, S. W. Obendorfer. These, with the following, compose the new executive committee. Guy C. Littler, S. C. Jaggar, E. Pierce and J. R. Tomlinson.

Kansas City Jovians to Revise Constitution.—The Jovian Electric Club of Kansas City, at its regular meeting Oct. 27, appointed a committee to revise the constitution so that the club can become a constituent member of the Jovian Order under the new federalization plan. Martin Wolf of St. Louis gave an address on Jovianism. L. E. Shoemaker was elected secretary, succeeding L. G. Schumacher, resigned.

Engineering School Opportunities.—On Nov. 14 Dr. C. R. Mann, of New York City, special investigator of the Carnegie Foundation for the Advancement of Teaching, spoke before the members of the Pittsburgh section of the American Institute of Electrical Engineers on "The Opportunity of the Engineering School." The members of the Engineers' Society of Western Pennsylvania were invited to participate in this meeting.

Home Lighting to Be Discussed at Cleveland.—The Pittsburgh section of the Illuminating Engineering Society will hold a joint meeting with the Cleveland section of the American Institute of Electrical Engineers at the Cleveland Electrical League rooms, Hotel Statler, Cleveland, on Nov. 20. The speaker will be H. T. Spaulding, National Lamp Works of the General Electric Company, Cleveland, who has taken as his subject "The Lighting of the Home."

New York Independent Contractors Hold Dinner.—The Independent Electrical Contractors' Association held its annual dinner at Mouquin's on Oct. 18. Addresses were delivered by President Louis Freed, A. Newburger, A. Whitely, W. D. Munro and Messrs. Bettman and Hanst. L. H. Woods explained how business should be conducted and put on a more professional basis. Mr. O'Day spoke on the "Ethics of Business," pointing out a way in which business can be obtained by approaching and explaining to prospective customers, instead of sending them estimates and then forgetting all about them.

Meeting of Iron and Steel Electrical Engineers. — The regular monthly meeting of the Association of Iron and Steel Electrical Engineers was held at Fort Pitt Hotel, Pittsburgh, on Nov. 18.

Associations and Societies

A complete Directory of Electrical Associations is regularly printed in the first issue of each month on the next-to-last text page.

David Wright presented a paper on "Variable Speed Alternating-Current Motors for Mill Drive." The December meeting of the Pittsburgh section will be held on Dec. 9, under the direction of the standardization committee, F. D. Egan, chairman. The December meeting of the Philadelphia section will be held at the Majestic Hotel, Philadelphia, on Dec. 2. Mr. David M. Petty will present a paper on "Alternating-Current Phase-Wound Motors versus Adjustable Speed Direct-Current Motors."

Scientists to Meet in New York in December.—The American Association for the Advancement of Science, and more than thirty national scientific societies affiliated with it, will meet in New York City during the last week of December, under the auspices of Columbia University, New York University, the College of the City of New York, the American Museum of Natural History and the other educational and scientific institutions of the city.

Schenectady Section of Institute Sees Experiments on Electron Theory.—The 177th meeting of the Schenectady section of the A. I. E. E. was held on Nov. 17. Charles T. Knipp, Professor of Physics at the University of Illinois, performed some fundamental experiments on the electron theory. Among the experiments performed were: Low potential direct-current discharge between concentric cylindrical electrodes; electronic discharge exhibiting phenomena similar to the aurora borealis; and color effect of positive and of cathode rays in residual air, hydrogen, argon and neon.

Ohio Transmission Committee Meeting.—An open meeting will be held on Nov. 22, at Dayton, Ohio, by the transmission and distribution committee of the Ohio Electric Light Association. O. H. Hutchings, associate general manager of the Dayton Power & Light Company, will make the address of welcome, followed by a paper on "Distribution-Transformer Stations," by R. R. Krammer, Ohio Light & Power Company, Newark. At the afternoon session W. E. Beaty, Union Gas & Electric Company, Cincinnati, will deliver a paper on "Distribution."

A "How" Report on Industrial Lighting.—On Nov. 6, fourteen members of the industrial lighting committee of the Lighting Sales Bureau of the National Electric Light Association met at Chicago to plan a report for the next national convention. Realizing that the report of last year's committee on this subject explained exhaustively why companies should seek industrial lighting business, they determined to make the report this year tell how to get this business. The report as it is now outlined will contain data, photographs and sketches from typical installations of good industrial lighting in practically all industries. James J. Kirk of the Commonwealth Edison Company is chairman of the committee.

Program of Cleveland Open Conference of Meter Committee, N. E. L. A.—The first open conference of the N. E. L. A. meter committee will be held at Cleveland, Ohio, Nov. 24. The opening session will be held at the Illuminating Building, and will be in charge of C. H. Ingalls, of the Boston Edison Company, chairman of the committee. There will be an address on "Meter and Instrument Bearings," by A. L. Ellis, of the Standardizing Laboratory, General Electric Company, West Lynn, Mass., followed by a paper (author unannounced) on "An Operating Company's Experience with Watt-Hour Meter Bearings." After a general discussion, adjournment will be taken for luncheon, at the rooms of the Cleveland Electrical League, Hotel Statler. The afternoon session will be held at the meter laboratories of the Cleveland Electric Illuminating Company, and will be in charge of A. H. Bryant, chairman of the meter committee of the Ohio Electric Light Association. Those attending will have an opportunity to inspect the building and its equipment. The program consists of an address of welcome by a local representative of electrical science, and a paper on "Testing Equipment for Service Meters," by G. E. Snider, Toledo, Ohio. A general discussion, with questions and answers, will follow.

New York Companies Section N. E. L. A., Hear of City's Growth.—The second meeting of the New York Companies Section, N. E. L. A., was held jointly with the Association of Employees of the United Electric Light & Power Company at the Consolidated Gas Building, New York City, on Nov. 14, with the new chairman, Walter Neumuller of the New York Edison Company, presiding. Sheriff Alfred B. Smith of New York, who was the speaker of the evening, was introduced by Frank W. Smith, general manager of the United company. In the course of his remarks, Sheriff Smith had occasion to present a number of interesting statistics showing the tremendous growth and development of the metropolis. Of particular interest were the figures he had compiled to show the growth of the city from the standpoint of lighting. The first lighting was in 1667, when every seventh householder was directed to hang a tallow-candle lantern out his window. Almost a century later, in 1762, the first lamp-posts were installed. Gas was first used in New York in 1825. In 1893 the streets of the city were lighted by 26,524 gas lamps and 1535 electric lamps. To-day the situation is reversed, electric lamps having largely displaced the gas lamps. Of a total of 78,501 gas and electric street lamps, 59,245 are electric. The evening concluded with a vocal and instrumental musical entertainment.

REVIEW OF TRADE AND MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

PRICE OF COPPER SOARING

Advance of Approximately 3 Cents a Week for Prompt Delivery

On Tuesday of this week the price of electrolytic copper had advanced to 32.5 cents nominal for prompt delivery. The advance during the week was 2.75 cents. Prices of copper which have been advancing daily for the past ten days are making new high records for the year. Prompt second-hand copper was offered early in the week at 33 cents, 32 cents bid.

Just at present indications are that 35-cent copper is practically certain and 40-cent copper probable before the end of the current year. Nor is it probable that any relief will be offered by the coming of the new year. Already bids have been made for first quarter delivery at 30.5 cents, with 31 cents asked. For the second, third and fourth quarters the metal is being held for 30.5, 29.5 and 29 cents, respectively.

RECENT DEVELOPMENTS IN BATTERY CHARGING SETS

Almost Universal Use of Storage Batteries on 1917 Gasoline Cars Causes Manufacturers to Prepare for Winter Season

Within the past few months there has been placed on the market a number of very compact battery charging sets, most of which are of the motor-generator type. They have been designed especially for use in garages.

Now that the storage battery is finding practically a universal use on the gasoline car for lighting, the garages have been faced with the necessity of caring for this equipment. In spite of the fact that most all cars are provided with charging generators there are frequently occasions when garages are called upon to recharge the batteries. Particularly is this true in cold weather when frequent charging becomes necessary.

A demand arose for a piece of charging apparatus that could be sold to public garages, and resulted in a number of manufacturers of motors placing sets on the market. The similarity of these sets is noticeable. Compactness and simplicity is the predominant character.

Every public garage and many of the large private garages form the prospect list of buyers, and provided the manufacturers can secure sufficient factory space for the manufacture of the sets in large numbers, it seems quite probable that the sale of these machines will reach large proportions.

PRESENT CONDITIONS OF NEW CONSTRUCTION

The Bulk of the Demand on Electrical Manufacturers Is for Equipment of Existing Industrial Plants

For twelve months now electrical manufacturers have been working night and day in an endeavor to meet the demand. Markets have been opened up that previously seemed inaccessible. Formerly business grew with new building but the amount of the latter in the United States in the past two years has been decreasing. The bulk of the electric business, therefore, has been chiefly in equiping old buildings, not so much domestic but industrial.

Because of this and high prices central station circuits have not been greatly extended and additions to equipment have been made only when absolutely necessary. In fact, there probably never has been a time in the history of the industry when so many central stations have been running so near the capacity of their stations.

A large amount of domestic building has been deferred for better prices. The money is at hand and as soon as building materials are reduced to the point where the houses can be put up on their original estimates this kind of new building will be stimulated.

In the railway field construction is almost at a standstill. As soon as labor becomes plentiful and prices come down there will undoubtedly be a large amount of buying done by this field.

A recent issue of *Dunn's Review* shows that permits were taken out in October last, calling for an expenditure of money 20 per cent greater than in October, 1915. On the face of it the returns would indicate that building was greatly on the increase.

On the other hand, the apparent growth is one of value and not of volume, and it is highly doubtful if due consideration is given to the increased cost of labor and all building materials, that there has actually been an increase. Rather is it more probable that the new building this year is from 10 to 20 per cent less than at the same time last year. Such a condition naturally would be reflected in certain electrical markets in ordinary times; but since the manufacturers do not complain it is evident that they have found other outlets for their product. Central station outputs are also greater, and, despite coal and labor conditions, prices are cheaper. This is due chiefly to the fact that the load factors of the station have been materially improved.

NATIONAL INDUSTRIAL CONFERENCE BOARD FORMED

Co-operative Body to Study Problems Which Confront American Manufacturers and to Provide Clearing House of Economic Information

A co-operative body, composed of representatives of national organizations of industrial employers, has been formed under the title of the National Industrial Conference Board in order to provide a clearing house of economic information, a forum for constructive discussion, and machinery for co-operative action on matters that vitally affect industrial development. The primary purpose in the formation of this board is to study the problems which confront the manufacturer in this country and to deal with changing world conditions, affecting all industries. Heretofore, to a substantial extent, each manufacturer has studied only the problems directly affecting himself, ignoring the fact that all industry is inter-related and that there is a vital need for co-operative action and united effort. The board will be a clearing house of information.

Summarizing the propositions involved in the formation of the body, the purposes of the National Industrial Conference Board may be stated as follows:

1. To stimulate the keen interest and active assistance of employers toward constructive study and equitable solution of economic issues in industry.

2. To foster maintenance of harmonious relations between employer and employee and between both and the government.

3. To assist in the formulation and enactment of sound and constructive economic legislation by presenting publicly to legislators the fundamental facts involved in the legislation and their effect.

4. To bring about genuine co-operation between the government and industry so that legislation hampering and restricting industry unnecessarily or unjustly may be avoided by a knowledge of the facts.

5. To present to the public facts showing the national benefits of industrial prosperity and the effect on employers and employees and consumers, and to stimulate, by accurate and truthful publicity, intelligent sympathy for all proper efforts for industrial development.

6. To stimulate the employer to maintain good conditions of work; to provide fair treatment for his workers and to take a personal interest in them.

7. To develop among the employees a reasonable attitude toward manufacturers and other industry, to inspire a sense of fair play, efficiency and loyalty.

The board is composed of Chairman Frederick P. Fish of Fish, Richardson, Herrick & Neave, Boston, Mass., and Manager Magnus W. Alexander, General Electric Company, West Lynn, Mass., with representatives from the following membership: National Founders' Association, National Metal Trades Association, National Council for Industrial Defense, National Association of Manufacturers, National Erectors' Association, National Association of Cotton Manufacturers, American Cotton Manufacturers' Association, National Association of Wool Manufacturers, Silk Association of America, United Typothetæ and Franklin Clubs of America, American Paper and Pulp Association and Rubber Club of America.

JOBBERS FAVOR OUTLET BOX NUMBER STANDARDIZATION

Fourteen Reasons Put Forth Why Manufacturers Should Use the Same Numbers to Designate Types Not Distinctly Different

Because there are over seven times as many outlet box numbers listed by manufacturers as there are distinct types of boxes there is a movement in the trade in favor of the adoption by manufacturers of standard outlet box numbers for similar types. At the recent Cleveland meeting the Electrical Supply Jobbers Association voted as being unanimously in favor of the movement, citing fourteen different reasons for standardization. These reasons are as follows:

"1. There are at present approximately 1500 different numbers used in designation of boxes and covers of various manufacturers. There are, however, less than 200 distinct types.

"2. Each manufacturer now has his own system of numbering, although the use and general type of almost any box or cover is identical with that of several manufacturers.

"3. Both contractors and jobbers, in placing orders, will rarely ever take the trouble to look up and use the numbers of the manufacturer with whom the order will be placed. This necessitates the editing of orders by either the jobber or manufacturer and must necessarily result in numerous errors. On orders received from contractors the jobber will almost invariably substitute the numbers of such boxes as he may have in stock, if shipment is to be made from stock, for those specified on order; or, in case direct factory shipment is to be made, forward the order as received to the manufacturer with whom he may be placing his box orders at that particular time. This is invariably done unless the purchaser insists upon the particular make of boxes specified.

"4. The types and styles of boxes and covers have become so standardized as to be almost on the same basis as sizes of conduits; there is, therefore, no more reason why different numbers should be used to designate the same box manufactured by different manufacturers than that different numbers should be used to designate the sizes of conduits.

"5. With the various box manufacturers using separate numbering systems, it is now necessary for the device manufacturers to use as much space in listing the boxes or covers with which their receptacles, switches, attachment plugs, etc., may be used as to list the articles themselves. This is also applicable inversely; about as much space is used in catalogs of the box manufacturers in listing the devices as in listing the boxes and covers themselves. Then, again, it is almost the universal custom of the various box manufacturers to list the corresponding numbers of competing manufacturers. To do this requires additional space.

"6. For the box manufacturers to furnish the device manufacturers with the necessary data for a proper listing involves an enormous amount of detailed research work by the design, engineering and drafting departments of each; also voluminous correspondence. Errors are frequent. Both labor and errors could therefore be reduced to a minimum through a standardization of numbers.

"7. For the various manufacturers to adopt a standard set of numbers would effect a considerable economy in catalog costs, and, in addition, reduce the volume of jobbers' catalogs. By the adoption of a standard set of numbers the sheets now issued by the jobbers' association could be consolidated and one set of sheets used to show the lines of all manufacturers. This would reduce the volume of the association catalog by from 100 to 200 pages. The same would apply to the National Electrical Contractors' Association data sheets.

"8. The reduction in the volume of sheets would be particularly appreciated by jobbers' salesmen, as it would considerably reduce the weight of the catalogs which they have to carry.

"9. A jobber, in getting out a new catalog, would feel no hesitancy in listing a standard set of numbers, cuts, etc., for he could so list and place his orders with any manufacturer; at the present time jobbers are frequently carrying the listing of one manufacturer's line and furnishing boxes of some other manufacturer.

"10. Separate numbering systems, as now used, give recognition to substitutes, which, at best, is a bad practice and not to be encouraged. If encouraged in one line, as at present in the outlet box line, leeway is allowed for substitution in all lines.

"11. The adoption of a standard numbering system would prove educational to all in the electrical business, for contractors, salesmen, wiremen, clerks, etc., would soon become familiar with any system adopted and know that an XYZ box was a box of a particular type and for a certain use. With so many different numbers, as is now the case, this is impossible.

"12. While some advantage might now accrue to the various manufacturers through familiarity of portions of the trade with their own 'pet' numbers, the adoption of a standard set of numbers would prove reciprocal, and each manufacturer would benefit in about the same proportion.

"13. The selection of a numbering system should be comprehensive and at the same time of such elasticity as to allow for additions, changes, revisions, etc. It is suggested that a system along the lines of that used by a certain company is the best now in use. In this system the first two numerals of each box number designate the size and shape of the box; the last two numerals designate the general type and use, arrangement of knockouts, etc., and most particularly the size of the knockouts. It is unnecessary to specify anything other than the number of the box and finish desired. The same general scheme is carried out in numbering the covers. The numerals indicate the size and shape and the letters indicate the type and use. In all cases the numerals used in designating covers correspond with the first two numerals of the boxes with which they can be used.

"14. The adoption of a standard set of numbers would in no way interfere with the various manufacturers playing up the strong points of their own lines, such as finish, detailed construction, materials used in manufacture, etc. As a matter of fact, these features could be emphasized more than is now possible. The contractor, in ordering, if he wanted some particular make of box, could specify by giving the name or brand and then list the standard numbers desired. This would reduce substitution to a minimum, eliminate frequent errors, etc. If no particular brand was specified, the jobber would, of course, understand that no preference existed, and could ship from his stock, or place order for direct shipment with his preference of manufacturers."

Manufacturing and Industrial

Clarence W. Marsh, engineer, announces the establishment of his New York office at 101 Park Avenue, New York, N. Y.

The Alphaduct Company, Jersey City, N. J., has filed plans for a new four-story plant on Cator Avenue, to be used for the manufacture of conduit tubing. The structure will cost about $15,900.

James Leffel & Company have appointed L. B. Dow, Inc., 136 Federal Street, Boston, Mass., their New England sales engineer. The company manufactures turbine water wheels, steam engines, and boilers.

Nelson S. Moore has resigned as assistant general manager of the Electrical Engineers Equipment Company of Chicago to enter the employ of Lewis & Roth Company of Philadelphia as sales engineer.

Westinghouse Electric & Manufacturing Company, Westinghouse Lamp Company and R. D. Nuttall Company announce the removal of their San Francisco offices to the seventh floor of the First National Bank Building, 1 Montgomery Street.

The Matthews Engineering Company, Port Clinton, Ohio, has decided to move its plant to Sandusky, where special inducements in the way of location and buildings were offered it. The company manufactures farm and individual residence light systems.

New Market for Arc Welding Sets.—A comparatively new market for electric arc welding sets, it is said by the Westinghouse Electric & Manufacturing Company, has been developed by the sale of a 300-amp. outfit to a large paper mill in New England.

Cracraft, Leich Electric Company, Genoa, Ill., announces that hereafter it will be known as the Leich Electric Company. The only change made is in the corporate name, as the stockholdings remain practically the same and the company will be under the same management as heretofore.

Valentine Clark Company, Minneapolis, states that reports of the burning of its entire yards and pole stock were incorrect statements. The company was fortunate in not losing its buildings, tools and treating plants, nor a substantial part of its Western red cedar poles. It is now prepared to handle from its Minnesota transfer yard orders for Northern or Western red cedar.

Hobart Manufacturing Company of Troy, Ohio, which manufactures electric coffee machines, has made arrangements to establish a branch in Cincinnati for the handling of certain work on its machines, on account of its inability to find the necessary number of skilled workmen in Troy. The company has leased 5000 sq. ft. of space in the Shillito Building, and will manufacture parts of its machine, which will be shipped to Troy for assembling at the main plant.

M. G. Kopf, formerly chief engineer for the McCormick Laboratories at Dayton, Ohio, has opened a consulting engineering office at 602 Chemical Building, Chicago. Mr. Kopf has organized a staff which, in addition to regular consulting engineering work, will render a broad service in the chemical, electrical and mechanical patent fields. This service will differ from the ordinary patent service in that it will be based primarily on scientific engineering and manufacturing knowledge, combined with legal advice, rather than primarily on legal ability. Mr. Kopf has been chief engineer of the technical laboratories of the Automatic Electric Company and electrical engineer for the National Cash Register Company.

President to Push Bill Authorizing Combination for Export Trade.—Reports from Washington state that because of the probability that the next House will lack a Democratic majority by several votes, President Wilson is laying plans to secure as much as possible of the constructive legislation he has advocated during the short session opening next month. One matter which it is expected will be pressed with the convening of the session, is the measure authorizing American exporters to establish common selling agencies abroad in order to compete with foreign practices. Opposition to this measure is expected in both houses on the ground that it means a weakening of the Sherman anti-trust law at home.

Adams-Bagnall Installs Porcelain Enameling Plant.—The Adams-Bagnall Electric Company of Cleveland, Ohio, is now completing an addition to its factory with the installation of a complete vitreous or porcelain enameling plant. The primary object of this addition is to further improve the quality and service of the "Abolite" line of porcelain enameled reflectors for industrial lighting, the porcelain enameled reflectors used in the company's pendent fixtures for street lighting and inclosed arc lamps, as well as some parts used in the manufacture by this company of transformers, electric fans and auto electrical accessory equipment. The steadily increasing demand for "Abolite" reflectors as well as faith in the maintenance of this growth has led the company to make this investment in order to insure increased production facilities and elimination of the extra hauling and handling that is the general practice in the manufacture of enameled steel reflectors. The enameling plant is being equipped for all classes of high-grade vitreous enameling. A battery of four 12-ft. furnaces will be supplemented with complete equipment of mixing vats, smelt furnaces, drying ovens and handling apparatus capable of producing a large output. In addition to enameling all "Abolite" reflectors and associate equipment, the Adams-Bagnall plant will be capable of handling a considerable output of other vitreous enameling work. The plant will be in full operation before Jan. 1, 1917.

Hess-Bright Not Controlled by S. K. F.—To correct misleading rumors and statements the Hess-Bright Manufacturing Company, Philadelphia, makes the following announcement: "A group of bankers, including Frank A. Vanderlip, Philip W. Henry, Thatcher M. Brown and Franklin B. Kirkbride of New York, and Marcus Wallenberg of Stockholm, has recently acquired from the American group of stockholders a controlling interest in the shares of the Hess-Bright Manufacturing Company. This group of bankers owns also a substantial interest in the S. K. F. Ball Bearing Company of Hartford, Conn. The two companies will be operated quite independently of each other. The former policy of the Hess-Bright Manufacturing Company will be continued except that its manufacturing facilities will be increased somewhat more rapidly to meet the constantly growing demand for its product. B. D. Gray, who retains his former stock holdings, will continue to manage the business as president. F. E. Bright retires from active participation in the company's affairs, but remains identified with the company as chairman of the board. Aside from these two changes, the organization remains as before. The directors are: F. E. Bright, chairman; B. D. Gray, president of the Hess-Bright Manufacturing Company; Willard Parker Butler of New York City; Arthur V. Morton, vice-president of the Pennsylvania Company for Insurance on Lives and Granting Annuities, of Philadelphia, and Paul von Gontard, managing director of the Deutsche Waffen und Munitions Fabriken, Berlin, Germany.

NEW YORK METAL MARKET PRICES

	Nov. 6 — Selling Prices		Nov. 14 — Selling Prices	
	Bid	Asked	Bid	Asked
Copper	£ s d		£ s d	
London, standard spot	124 0 0		128 10 0	
Prime Lake	28.50	to 29.00†	31.50	to 32.00†
Electrolytic	29.50	to 30.00†	32.00	to 33.00†
Casting	27.75	to 28.00†	30.00	to 30.50†
Copper wire base	35.25†		37.25†	
Lead	7.00		7.00	
Nickel	50.00		50.00	
Sheet zinc, f.o.b. smelter	16.00		17.00	
Spelter, spot	10.67½	to 10.92½	11.42½	to 11.55
Tin, straits	42.50		44.37½	
Aluminum, 98 to 99 per cent	58.00	to 60.00	58.00	to 60.00

OLD METALS

Heavy copper and wire	24.50	25.00†
Brass, heavy	14.75	15.00†
Brass, light	11.00	11.50†
Lead, heavy	6.25	6.37½†
Zinc, scrap	7.25	7.75†

COPPER EXPORTS

Total tons to Nov. 14 7,202

†Nominal.

Corporate and Financial

Central Illinois Public Service Company, Mattoon, Ill.—At a dinner given by bankers interested in a recent bond issue of the company to show bond dealers the extent and variety of the company's properties, some interesting statistical information was disclosed. Thus, of sixty-four generating stations originally supplying this company's territory, forty-one have been shut down, thirteen are now operating, and ten are held in reserve. The company has 846 miles of transmission line, 49,442 customers of all classes, a connected load of about 69,000 hp., and an annual output of about 40,000,000 kw.-hr. The population served is estimated at 285,000, and the gross earnings for 1916 (with the last three months estimated) are $2,189,250.

Eastern Pennsylvania Railways Company, Pottsville, Pa.—The annual report of the company for the fiscal year ended June 30, 1916, the largest year in the history of the company, has just been received. A comparative consolidated statement of earnings and expenses for the last two fiscal years follows:

	1915	1916
Gross earnings	$825,455	$901,490
Operating expenses and taxes	486,570	549,647
Net earnings	$338,885	$351,843
Deductions (all companies)	227,783	232,135
Surplus (available for renewals, depreciation, amortization, financial requirements of the company and dividends)	$111,102	$119,708

Edison Electric Illuminating Company of Boston, Mass.—The stockholders of the company, at a special meeting, voted to authorize the president to petition the Massachusetts Gas and Electric Light Commission for authority to issue stocks not exceeding 22,528 additional shares, proceeds to pay for additions and extensions.

Northern California Power Company, San Francisco, Cal.—An assessment of $1 per share has been levied by the company on its capital stock, to be paid by Nov. 28. Net earnings are running well above all requirements for fixed charges, and it is thought that money from the assessment is required to meet maturing obligations or for past due debentures.

Pacific Gas & Electric Company, San Francisco, Cal.—A supplemental hearing was held on Nov. 9 before the California Railroad Commission to issue stock. The application involved the expenditure of approximately $2,250,000, obtained or to be obtained from the sale of stocks and bonds authorized to be issued by the commission's decision dated Jan. 3, 1916. In this decision the commission authorized the company to issue on or before Dec. 31, 1916, $2,500,000 par value first preferred stock at not less than $90 a share, and $2,000,000 face value general and refunding bonds at not less than 85 per cent of face value, plus accrued interest. The company said at the hearing that it has sold all of the $2,000,000 bonds, and has realized $1,780,870. Also up to Aug. 31 last it had sold 9072 shares of first preferred stock for $830,497.59. The average price per share was $91.54. Up to Oct. 18 the company had received in cash $910,697.50 for preferred stock. In addition to the construction authorized by the commission, the company said that it had expended or will expend $2,500,756.39 for extensions and betterments of its plant, of which $1,850,000 was for the construction of its hydroelectric plant on the South Yuba River.

Texas Power & Light Company, Dallas, Tex.—W. B. Head, assistant to the president, makes the following statement in regard to the plans of the company: "More than 300 miles of high-tension transmission lines are now being operated by the Texas Power & Light Company of Dallas, which recently completed its connections between Paris and Waco. Paris, Waco, Bonham, McKinney, Denison, Temple, Taylor and Fort Worth are now connected, the last named being with the Fort Worth Power & Light Company. Plans are now being considered for further extensions of the Texas Power & Light Company, and it is contemplated to build a large central generating station at Austin, to be followed by the extension of transmission wires to San Marcos, New Braunfels and San Antonio. The Southern Traction Company contemplates extending its interurban railway from Waco to San Antonio, and this would require a large portion of the electricity developed at the Austin plant."

New Utility and Industrial Companies

The Vocaphone Corporation of New York, N. Y., has been chartered with a capital stock of $300,000 to manufacture and deal in electrical and mechanical devices of all kinds. The incorporators are: Arthur W. Britton, L. P. Gunther and S. B. Howard, all of New York, N. Y.

The Schroeder Electric Company of Albany, N. Y., has been incorporated with a capital stock of $10,000 by S. M., A. A. and J. F. Schroeder, 13 Delaware Terrace, Albany, N. Y. The company proposes to deal in storage batteries, electric machinery, and to do contracting work.

The Electric Automobile Sales Corporation of New York, N. Y., has been incorporated by J. B. Purcell, F. H. Parcells and G. Tiernan, 64 Wall Street, New York, N. Y. The company is capitalized at $10,000 and proposes to deal in cars, carriages, motor vehicles, machinery, engines, etc.

The North Side Battery & Electric Company, the Bronx, N. Y., has been incorporated by L. M., J. A. and J. F. Hanudel, 21 Lawrence Street, Flushing, N. Y. The company is capitalized at $10,000 and proposes to manufacture and deal in electric batteries, supplies and appliances.

Trade Publications

Gas Turbines.—The Detroit Gas Turbine Corporation of Detroit, Mich., has prepared an illustrated bulletin descriptive of its gas turbines.

Porcelain.—"Standard Electrical Porcelain" is the subject of an illustrated bulletin prepared by the Findlay Electric Porcelain Company of Findlay, Ohio.

Ball Bearings.—Applications of radio-thrust bearings are well described and illustrated in bulletin No. G-1 prepared by the Gurney Ball Bearing Company of Jamestown, N. Y.

Vacuum Pumps.—The Nash Engineering Company of South Norwalk, Conn., has issued bulletin No. 4 descriptive of its turbine vacuum and low pressure boiler-feed pumps.

High Tension Equipment.—The Railway & Industrial Engineering Company of Pittsburgh, Pa., has prepared a mailing folder descriptive of its Burke horn gap equipment for outdoor substations.

Ball Bearings.—Volume 1 of "Bearing on Bearings" has been received from the Gurney Ball Bearing Company of Jamestown, N. Y. The subject of this booklet is "War on Waste." It contains a motto, five short stories and a moral on the ball bearing.

Steam Pumps.—Catalog No. 14 descriptive of Nye steam pumps has been received from the Nye Steam Pump & Machinery Company of Chicago, Ill. This catalog containing sixty-one pages has been carefully prepared and is well illustrated, showing many pumps in service.

Underground Equipment.—A booklet prepared by T. J. Cope, 1620 Chancellor Street, Philadelphia, Pa., shows in a brief way the numerous devices patented by this company and to demonstrate the uses for which they are designed. The text is well illustrated and carefully prepared.

Sockets.—The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has distributed to the electrical trade a large broadside devoted to the publicity campaign on the C-H push socket. This broadside shows an illustration of a large display output which is given free to electrical dealers and contractors.

Industrial Trucks.—Electrical industrial trucks are well described and illustrated in a bulletin issued by Samuel L. Moore & Sons Corporation, Elizabeth, N. J. The truck described is for use in any manufacturing plant, warehouse, railway terminal or wherever material is to be moved or shipped in quantities.

Control Apparatus.—"Magnetic Switch Control Apparatus" is the title of the new booklet M published by the Cutler-Hammer Manufacturing Company of Milwaukee, describing alternating and direct-current types of magnetic switch control apparatus. In this thirty-two-page booklet there are seventy-nine illustrations showing the apparatus as well as installations of this apparatus. The system of automatic or magnetic switch type of control are clearly explained.

New England

LAKE VIEW, ME.—The Lake View Electric Company, recently organized with a capital stock of $5,000, contemplates the construction of electric power plant to supply electricity in Lake View plantation and in the town of Brownville. The company will also supply water for domestic purposes in Lakeview. E. H. Hamlin of Milo is president.

OQUOSSOC, ME.—The Oquossoc Light & Power Company has applied to the Public Utilities Commission for permission to issue $25,000 in capital stock.

BOSTON, MASS.—The stockholders of the Edison Electric Illuminating Company of Boston have authorized the president to petition the State Gas and Electric Light Commissioners for permission to issue not exceeding 22,528 additional shares of capital stock, the proceeds to be used to pay for additions and extensions.

BOSTON, MASS.—Bids will be received by the schoolhouse commissioners of the city of Boston, 1007 City Hall Annex, Boston, until Nov. 21 for construction of an elementary school for upper grades, Henry L. Pierce District, Dunbar Avenue and Torrey Street, Dorchester, Boston. A deposit of $25 will be required for a complete set of plans. For a set of heating and ventilating or electrical plans with specifications a deposit of $15 will be required.

LEOMINSTER, MASS.—The Connecticut River Power Company has secured the right of way for erection of transmission line from the southwestern part of the city to the plant of the Viscoloid Company's plant. The power company will erect its lines to the transformer house of the Leominster Electric Light & Power Company which is to be erected off Litchfield Street, near the Viscoloid Company's plant. Energy will be supplied through the Leominster company.

WATERBURY, CONN.—Plans are being prepared by the A. H. Wells Company of Waterbury for the construction of a power house, 45 ft. by 50 ft., at its new plant on East Aurora Street.

Middle Atlantic

BEDLOE'S ISLAND, N. Y.—The contract for lighting the Statue of Liberty, Bedloe's Island, has been awarded to the Public Service Electric Company of Newark, N. J. Service will be supplied by the installation of cables from Communipaw, N. J.

BINGHAMTON, N. Y.—The proposal for a more complete ornamental lighting system in Binghamton has been indorsed by the Advertisers and Merchants' Association.

BROOKLYN, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, Park Avenue and Fifty-ninth Street, New York, N. Y., until Nov. 27 for installing electric-light equipment in Public Schools 1, 12, 32, 75, 90 and 116, borough of Brooklyn. Plans, specifications, etc., may be obtained at the above office and also at branch office, 131 Livingston Street, Brooklyn.

COOPERSTOWN, N. Y.—The Colliers Light, Heat & Power Company of Cooperstown has applied to the Public Service Commission for permission to acquire the capital stock and take over the control of the Deposit (N. Y.) Electric Company; also to issue additional capital stock.

ITHACA, N. Y.—The Public Service Corporation has authorized the Ithaca Gas & Electric Corporation to purchase 2000 shares of capital stock of the Norwich (N. Y.) Gas & Electric Company for $200,000; 2276 shares of stock of the Oneonta (N. Y.) Light & Power Company for $227,600, and 1474 shares of stock of the Homer & Cortland Gas Light Company for $147,400. After consolidating the three properties the Ithaca company will extend and improve them and connect their lines to its own high-tension transmission system.

JORDAN, N. Y.—Negotiations are under way for the purchase of the plant of the Jordan Electric Light & Power Company by F. W. Knapp, owner of the Marcellus electric plant. A new company, it is understood, will be organized to take over the properties. The local plant which served Jordan and Eldridge will be closed down and electricity will be supplied from the plant at Marcellus, which uses Niagara power. Franchises have been secured by Mr. Knapp in Jordan and Elbridge. New equipment, including transformers, transmission lines, etc., will be installed as soon as possible.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, Park Avenue and Fifty-ninth Street, New York, until Nov. 20 for furnishing tool equipments (and electric wiring for same) for shops, also electric wiring for vent motors, etc., duplicate school plan, in Public Schools 72, 101, 109, 168 and 171, borough of Manhattan. A separate bid must be submitted for each item in each school.

NEW YORK, N. Y.—Bids will be received by William Williams, commissioner of water supply, gas and electricity, Room 2318, Municipal Building, New York, until Nov. 23, as follows: (1) For furnishing and maintaining electric-lighting units for lighting public streets, parks and places from Jan. 1, 1917, to Dec. 31, 1917, inclusive; (2) for furnishing electric current for lamps and motors in public buildings and for furnishing and maintaining certain equipment during said period; (3) for performing sundry repair and other work to lighting equipment furnished by the city during said period, in the boroughs of Manhattan, the Bronx and Richmond. Blank forms of bids, including specifications, etc., may be obtained at Room 2324, Municipal Building.

NIAGARA FALLS, N. Y.—Plans are under way for rebuilding and extension of the hydroelectric plant of the Niagara Falls Power Company at Niagara Falls, which will involve an expenditure of $11,000,000. The output of the plant will be increased from 90,000 hp. to 180,000 hp.

SCHENECTADY, N. Y.—The capital stock of the Schenectady Illuminating Company has been increased from $3,000,000 to $5,000,000. The company, it is understood, contemplates a number of improvements to its system.

ALBION, PA.—The Northwestern Electric Service Company of Pennsylvania has been granted a franchise to erect electric transmission lines on certain streets of the borough and town of Albion and also to supply electricity for lamps and motors within the limits of the borough.

CARNEGIE, PA.—The Union Electric Steel Company of Pittsburgh, recently organized with a capital stock of $350,000, has purchased a site in Carnegie, on which it will erect a plant for producing electric steel. Heroult furnaces will be used. The first furnace will have a capacity of six tons. James D. O'Neil, former president of the United Coal Company, will be president of the new company.

FREEMANSBURG, PA.—The plant and holdings of the Freemansburg Electric Light & Power Company have been purchased by the Lehigh Valley Light & Power Company of Allentown.

JENKINTOWN, PA.—Plans are being prepared by Lawrence V. Boyd, architect, for the erection of a new building for the Philadelphia & Suburban Gas & Electric Company of Philadelphia in Jenkintown.

SOUTH BETHLEHEM, PA.—An association has been formed to raise funds for an adequate electric-lighting system on streets approaching the proposed new bridge over the Lehigh River to Bethlehem. The cost of the proposed lighting system is estimated at $14,000.

HIGHTSTOWN, N. J.—The Electric Light & Power Company is contemplating extensions to its local system in connection with the erection of the electric transmission line now being erected from Hightstown to Trenton.

JERSEY CITY, N. J.—Application has been filed by the Public Service Electric Company for permission to install a conduit system in Summit Avenue.

MERCHANTVILLE, N. J.—The Bell Telephone Company has been granted a franchise to install an underground conduit system in streets in the business section.

NEWARK, N. J.—The contract for electrical work in the new manufacturing plant of the General Leather Company, to be erected on Frelinghuysen Avenue, Newark, has been awarded to the Davis Electric Company, 54 Clinton Street, at $12,000.

NEWTON, N. J.—Bonds to the amount of $8,000 have been voted for the installation of an electric street-lighting system on the important thoroughfares in Newton.

BALTIMORE, MD.—The citizens have voted to appropriate $1,000,000 to continue the construction of underground conduits for electrical wires, the work to be done under the supervision of the Electrical Subway Company. Raleigh C. Thomas is chief engineer.

BALTIMORE, MD.—The Western Maryland Railway Company is issuing notes to the amount of $67,087 to provide funds for the installation of automatic block signals on the railroad of the Connellsville & State Line Railway Company, between Colmar and Greenwood, a distance of 66 miles.

MANNINGTON, W. VA.—The Monongahela Valley Traction Company of Fairmont has purchased the property of the Consumers Electric Light Company of Mannington. The new owners have taken over the plant and will erect a transmission line from the substation at Farmington to Mannington, a distance of 7 miles, to supply electricity from the central station at Hutchinson to operate the local system. The distribution system in Mannington will be rebuilt and rearranged to permit distribution at 2300 volts instead of 1100 volts.

SWITCHBACK, W. VA.—The Appalachian Power Company of Bluefield is planning to install a frequency changer, involving an expenditure of about $100,000, to enable the plant to interchange with the Norfolk & Western Railway Company's electrical transmission system; also to erect an electrical transmission line from Saltville, Va., to Dante, Va., a distance of 30 miles, at a cost of about $90,000. The Appalachian company has purchased the plant of the Clinchfield Coal Corporation at Dante and will equip it for a reserve steam plant. Contract has been awarded for the frequency changer.

CLARKSVILLE, VA.—The City Council is considering the question of issuing $7,500 in bonds for the installation of a municipal electric-light plant.

FORK UNION, VA.—The electric plant, we are informed, has already been installed at the Fork Union Military Academy. The management is still in the market for lighting equipment and supplies. An item published in the issue of Oct. 28 stated that the Military Academy was contemplating the installation of an electric plant. C. E. Crossland is president.

RICHMOND, VA.—The Administrative Board has rejected the proposals of the Virginia Railway & Power Company for furnishing electricity for power purposes in the city and for exchanging power service between the municipal plant and the company' plant. The board has awarded a contract to the General Electric Company for a steam turbo-generator set, at $20,340.

WILLIAMSBURG, VA.—The Williamsburg Electric Light & Power Company, which has a franchise to supply electricity here, it is reported, has purchased the property of the Williamsburg knitting mills, for $33,000.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Various, Schedule 347—23,000 dry cells; Schedule 360—miscellaneous desk and bracket fans. Norfolk, Va., Schedule 341—one 15-ton locomotive crane. Brooklyn, N. Y., Schedule 338—furnishing and installing miscellaneous laundry machinery. Philadelphia, Pa., Schedule 343—one 12,000-gal. storage tank. Key West, Fla., Schedule 342—nine fixed-socket type thermometers. Puget Sound, Wash., Schedule 358—16 turbine tube cleaners, 2 in. and 4 in. Newport, R. I., Schedule 378—4000 copper cups, two turbine bucket cutting machines. Mare Island, Cal., Schedule 358—six water-tight annunciators (type B), 44 lb. nickel chronium resistance wire. Mare Island and Puget Sound, Schedule 358—29 heavy electric soldering irons. Boston, Mass., Schedule 370—14 water-tight controlling panels. Washington, D. C., Schedule 377—two 5-in. universal radial drills, one heavy duty press drill; Schedule 362—one surface grinding machine, one universal milling machine. Charleston, S. C., Schedule 364—two turbo-generating sets. Applications for proposal blanks should designate the schedule desired by number.

North Central

ALLEGAN, MICH.—The proposal to issue $6,000 in bonds for the installation of a municipal street-lighting system is under consideration.

ALMA, MICH.—W. J. Sherman, of Toledo, Ohio, consulting engineer, has been engaged to prepare plans for installation of a municipal water-works system, including mains, pumping station and hydroelectric power.

GRAND RAPIDS, MICH.—Residents on East Leonard Street have subscribed $7,500 for the installation of an ornamental lighting system on that thoroughfare.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

MULLIKEN, MICH.—The Council will soon call a special election to vote on the proposal to grant J. H. Hensky a franchise to supply electricity in Mulliken. If granted a franchise Mr. Hensky has offered to install a plant and wire the town.

PETOSKEY, MICH.—Work on the reconstruction of the municipal water power plants have been postponed until spring.

PETOSKEY, MICH.—The local paper mill, recently damaged by fire (which is a branch of the Wheat Paper Company of Elkhart, Ind.), will resume operation as soon as repairs are made and new buildings erected. The municipal plant will supply the mill electricity (without charge) for six months, to give the company an opportunity to build a fireproof power plant.

PORT HURON, MICH.—The Port Huron Gas & Electric Company has submitted a proposal to the City Council offering to install a new street-lighting system. The present contract expires Dec. 31.

CANAL DOVER, OHIO.—Plans are being prepared by the Millersburg & Western Railroad Company for the construction of an electric railway from Canal Dover to Millersburg. The work will include 35 miles of single track, power house and two substations. D. F. A. Wheelock of Warren, Pa., is engineer.

CINCINNATI, OHIO.—Preparations are being made by the Cincinnati & Suburban Bell Telephone Company to erect a branch exchange building for the Woodburn exchange, to cost about $150,000.

CLEVELAND, OHIO.—A permit has been granted the National Artificial Silk Company for the erection of a power house at 9801 Wolford Road, to cost about $55,000.

CLEVELAND, OHIO.—At the election held Nov. 7 the proposal to issue $1,750,000 in bonds, the proceeds to be used for enlarging the municipal electric-light plant and distribution system, was approved by the voters. The city officials are negotiating with the Cleveland Railway Company, which proposes to close down its Cedar Avenue power house, to supply part of the energy for the railway system.

COLUMBUS, OHIO.—Plans are being considered by the Wilson Avenue Improvement Association for the installation of an ornamental lighting system on Wilson Avenue.

LIMAVILLE, OHIO.—Bids will be received by the Village Council at the office of the village clerk until Nov. 20 for furnishing material and installation of a lighting system or plant, according to plans and specifications on file in the office of the village clerk.

LORAIN, OHIO.—The Lorain County Electric Company, which supplies electricity in Lorain, Elyria, Amherst and other places is planning to rebuild and double the output of its plant. The improvements will cost about $250,000 and will also include the rebuilding of the overhead distribution system. Wires and poles will be removed to alleys.

ROCKY RIVER, OHIO.—The Council has granted the Cleveland (Ohio) Electric Illuminating Company a franchise to furnish electrical service in Rocky River. The Rocky River Water, Light & Power Company supplies electricity here, but does not furnish a day service.

TIFFIN, OHIO.—The City Council has awarded the Ohio Light & Power Company of Tiffin a contract for lighting the streets of the city for a period of ten years, at $10.451. Nitrogen-filled incandescent lamps will be used.

TOLEDO, OHIO.—Orders have been placed by the Toledo Railways & Light Company for a 20,000-kw. turbo-generator, increasing the output of its plant to 85,000 kw.

WARREN, OHIO.—Work will soon begin on the erection of the first unit of the new plant of the Westgard Tire & Rubber Company, which will include a building, 100 ft. by 240 ft., two stories and basement, and a power plant. W. C. Owen & Company of Cleveland are engineers.

YOUNGSTOWN, OHIO.—The Trumbull Mazda Lamp Company has awarded the contract for the construction of an addition to its plant (three stories high), to cost about $75,000, to the Heller Brothers Construction Company. Considerable new equipment will be required.

ALEXANDRIA, KY.—A company has been organized by the Business Men's Club to construct and operate an electric-light plant in Alexandria to supply electricity for both commercial and street-lighting. The company is capitalized at $2,000. Dr. N. G. Zinn, James H. Gosney, Andrew Turner and G. S. Phillips have been appointed a committee to investigate the matter.

LEXINGTON, KY.—Plans are being considered by the City Commissioners for improvements to the street-lighting system on Main Street. It is proposed to place the electric wires between Limestone Street and Broadway underground.

MORGANFIELD, KY.—The electric lighting plants at Morganfield and Uniontown have been purchased by the Kentucky Utilities Company of Lexington. Contracts have been placed for new equipment for the plant at Morganfield; also for material for erection of transmission line to connect Uniontown and Morganfield, Harry Reid of Lexington, is president.

MURRAY, KY.—Bonds to the amount of $20,000 have been voted, the proceeds to be used for the installation or purchase of a municipal electric-light plant.

OLIVE HILL, KY.—The citizens have voted to issue $10,000 in bonds for the installation of a municipal electric-light plant and water-works system.

UNIONTOWN, KY.—The local electric-light plant has been purchased by the Kentucky Utilities Company of Lexington. A transmission line will be erected from Morgantown to Uniontown.

CLINTON, IND.—The Clinton Electric Light & Power Company and the Sullivan (Ind.) County Electric Company have been consolidated under the name of the Wabash Valley Electric Company. The new company with two central stations, one at Clinton and the other at Sullivan, will furnish electricity in the towns of Clinton, Sullivan, Dana, Jacksonville, New St. Bernice, Hymera, Shelburn, Farmersburg, Jasonville and Coalmont. The Wabash company is capitalized at $250,000. H. C. Dies of Clinton is president.

LAFAYETTE, IND.—The Chicago, Indianapolis & Louisville Railway Company (Monon Route) is contemplating an addition to its local shops for use of the electrical department, requiring the installation of considerable equipment. W. H. Fogg is division superintendent.

CHICAGO, ILL.—Work, it is reported, will begin at once on equipping the Chicago, Milwaukee & St. Paul Railway from Deer Lodge to Alberton, Mont., a distance of 110 miles, for electrical operation.

CHICAGO, ILL.—Plans have been prepared by the Western Electric Company for the construction of a group of four five-story buildings to be erected as an addition to its large plant at Hawthorne, at a cost of about $700,000.

CHICAGO, ILL.—A building permit has been granted for the erection of a one-story steel and brick power house at Twenty-ninth Street and Sacramento Avenue, to cost about $120,000, for the city of Chicago. Charles W. Kallal is architect.

GRANVILLE, ILL.—The Putnam County Electric Company, recently organized by Sidney Whittaker, George W. Hunt and John G. Pletsch, has applied to the State Public Utilities Commission for permission to take over the electric-light plant in the city of Granville, distribution systems in Standard and Mark, and transmission lines between those towns, owned by Sidney Whittaker.

HEBRON, ILL.—The L. E. Myers Electric Company, which has been granted a franchise to supply electricity in Hebron, has changed its name to the McHenry County Electric Light & Power Company.

MAHOMET, ILL.—Steps have been taken to organize a company to operate an electric-light plant in Mahomet. The company will have a capital stock of $10,000. J. N. Black is interested.

MARINE, ILL.—The Southern Illinois Light & Power Company of Hillsboro is negotiating for the purchase of the electric plant of the Marine Electric Service Company.

MURPHYSBORO, ILL.—The Murphysboro Electric Railway, Light, Heat & Power Company has awarded the Heman Construction Company of St. Louis, Mo., a contract for the construction of an extension of its electric railway to Carbondale. The cost is estimated at about $200,000.

WINNETAKA, ILL.—Improvements are contemplated to the municipal electric-light plant, including the installation of a 500-kva., two-phase, 60-cycle, 2200-volt turbo-generator, to be completed by September, 1917. R. L. Fitzgerald is business manager.

ASHLAND, WIS.—The Ashland Light, Power & Street Railway Company is planning to increase the output of its power plant from 3000 to 10,000 hp. The boiler room will be enlarged and four 600-hp. boilers installed. A new concrete stack will also be erected.

CHETEK, WIS.—The Wisconsin Commission has granted the Chetek Light & Power Company permission to issue $12,500 in capital stock, $20,000 in bonds and $3,000 in notes for the purpose of acquiring the electric plant and distributing system in Chetek.

JACKSON, WIS.—The Jackson Electric Light & Power Company has applied to the Wisconsin Railroad Commission for permission to issue $1,000 in capital stock for the purpose of taking over the local electric plant, owned by Froelich Mercantile Company.

MILWAUKEE, WIS.—Improvements involving an expenditure of $100,000 to the auditorium in Milwaukee are contemplated, which will include new lighting and heating systems. J. C. Greib is manager.

MILWAUKEE, WIS.—Plans are being prepared by Leiser & Holst, Germania Building, Milwaukee, for the construction of the Washington Hotel, to be located at Fourth and Sycamore Streets, at a cost of about $300,000. The plans provide for three electric elevators, central heating plant, etc. Herman Pereles, Walter Kauwertz and I. Miller are owners.

NEENAH, WIS.—Plans are being considered by the John Strange Paper Company of Neenah for the construction of a new dam and hydroelectric plant at McDill, near Stevens Point. The company has purchased the property of the Wisconsin Graphite Company and proposes to establish a paper mill.

PARK FALLS, WIS.—The Flambeau Paper Company of Park Falls has engaged T. W. Orbison of Appleton, architect and engineer, to prepare plans for a power dam, hydroelectric plant and paper mill on the Flambeau River, near Park Falls. The cost of the project is estimated at $125,000. Guy Waldo is secretary.

REESEVILLE, WIS.—The Wisconsin Gas & Electric Company of Kenosha has purchased the property and holdings of the Reeseville Light & Power Company and the Marshall (Wis.) Electric Company and will extend the transmission line, now being erected to Clyman, to Reeseville.

DULUTH, MINN.—The directors of the Great Northern Power Company have authorized an issue in bonds to provide funds for improvements and extensions to its system, among which is the erection of an electric transmission line from Thomson to Virginia, to enable the company to give a more satisfactory service in the Mesaba range towns.

ELY, MINN.—A new 350-kw. Westinghouse generator and Lentz engine is being installed in the municipal electric-light plant. William Mitchell is superintendent.

GHENT, MINN.—The Citizens' Light Heat & Power Company has been granted a franchise to install and operate an electric-light and power plant in Ghent.

HAWLEY, MINN.—A new gas engine and gas producer is now being installed in the municipal electric-light plant. A 300-gal. per minute Smith Vaile triplex pump has recently been installed in the municipal electric-light and water plant. The purchase of a 40-kw., two-phase, 2300-volt alternator (second hand), directly connected or belted, is under consideration by the board of managers, who would like to receive prices on same. Address all quotations to N. A. Lee, superintendent.

MORTON, MINN.—The Northern States Power Company of Chicago, Ill., has been granted a franchise to supply electricity in Morton for a period of 15 years.

BLOCKTON, IOWA.—The property of the Blockton Light & Power Company has been taken over by David G. Fisher & Company, of Davenport.

BONDURANT, IOWA.—The Board of Railroad Commissioners of Iowa has granted the town of Bondurant a 25-year franchise to erect an electric transmission line upon the highways and road of Polk County. The town contemplates establishing a municipal electric-light system and will secure electricity from the Inter Urban Railway Company of Des Moines.

CENTERVILLE, IOWA.—The Centerville Light & Traction Company has been granted a 25-year franchise to erect and operate electric transmission lines on certain highways and road in Appanoose and Wayne Counties to supply electricity for lamps, heaters and motors. The company is contemplating the erection of a 33,000-volt transmission line from Centerville to Allerton, a distance of 12 miles. F. S. Payne, of Centerville, is president and manager.

DAYTON, IOWA.—The Board of Railroad Commissioners of Iowa has granted the town of Dayton a 25-year franchise to erect and operate an electric transmission line between Harcourt and Dayton in Webster County. The town is installing a municipal electric-lighting system and proposes to secure energy from the plant of the Fort Dodge, Des Moines & Southern Railroad Company at Harcourt.

GUTRIE CENTER, IOWA.—The Iowa Railway & Light Company of Cedar Rapids

contemplates the installation of a new 100-kw. generating unit at its local plant. C. T. Harney is manager.

MOUNT VERNON, IOWA.—Arrangements have been completed by the Wapsie Power & Light Company for extension of its transmission line to West Branch, a distance of about 30 miles.

WATERLOO, IOWA.—Bids will be received by the board of education of the independent school district of East Waterloo, First National Bank Building, Waterloo, until Nov. 27 for a system of electric clocks and bells, electric fixtures and conduit and telephones. W. H. Brunn is secretary.

BOWLING GREEN, MO.—The Bowling Green Mineral Springs Company is contemplating the installation of an electric-light plant and water-works system. J. H. Lynch, 625 Locust Street, St. Louis, is architect.

JOPLIN, MO.—The Empire District Electric Company of Joplin is contemplating improvements to its Spring River power plant, including the installation of three boilers. Orders have been placed for equipment for softening water. The cost of the work is estimated at $25,000.

SPRING HILL, MO.—Improvements are contemplated to the municipal electric-light plant, to cost about $4,000, for which bonds have been voted.

FLASHER, N. D.—Harry Thorberg and John Bunting of Mandan, N. D., have been granted a franchise to install an electric-lighting system in Flasher.

DELL RAPIDS, S. D.—Bids will be received by the city of Dell Rapids until Nov. 28 for the sale of $8,000 in bonds, the proceeds to be used for a municipal lighting system. James Ridlington is city auditor.

OMAHA, NEB.—The Charles W. Martin Company has awarded the contract to the Omaha Concrete Stone Company to furnish ornamental concrete lamp standards for the entire Minne Lusa addition. Several hundred posts will be required.

OMAHA, NEB.—Bids will be received by W. T. Bourke, secretary of board of education, 509 City Hall, Omaha, Neb., until Dec. 7 for construction of the Henry W. Yates School Building, separate bids to be submitted as follows: (1) Entire completed building; (2) general construction; (3) heating and ventilating, automatic heat control, vacuum system, plumbing and gas fitting; (4) electric wiring, etc. Copies of plans and specifications may be obtained at the office of John McDonald, architect, Omaha National Bank Building, Omaha, upon deposit of $25. Bids will also be received at the same time and place for the erection of the Field Club School Building, as follows: (1) Entire completed building; (2) general construction; (3) heating and ventilating, vacuum system, plumbing and gas fitting; (4) electric wiring, etc. Copies of plans and specifications may be obtained at the office of George B. Prinz, architect, New Omaha National Bank Building, Omaha, upon deposit of $25. Bids will also be received at the same time and place for the construction of the New Clifton Hill School Building as follows: (1) Entire completed building; (2) general construction; (3) heating and ventilating, vacuum system, plumbing and gas fitting; (4) electric wiring, etc. Copies of plans and specifications may be obtained at the office of the architects, Frederick W. and Edwin B. Clarke, Brandeis Building, Omaha, upon deposit of $25. Bids will also be received at the same time and place for construction of the Park School Building, as follows: (1) Entire completed building; (2) general construction; (3) heating and ventilating, automatic heat control, vacuum system, plumbing and gas fitting; (4) electric wiring, etc. Copies of plans and specifications may be obtained at the office of Thomas R. Kimball, World-Herald Building, Omaha, upon deposit of $25. Plans of the four schools will be on file at the Builders' Exchange of St. Paul and Minneapolis, Minn.; Des Moines, Iowa, and Omaha, Neb.

SARGENT, NEB.—Work has started on the construction of the proposed municipal electric-light plant, for which bonds to the amount of $7,500 were recently voted.

BUNKER HILL, KAN.—The installation of a street-lighting system in Bunker Hill is under consideration.

HAYS CITY, KAN.—At an election to be held Nov. 20 the proposal to issue $29,003 in bonds to purchase the property of the Hays Electric Light Company was carried. Improvements will be made to the plant and system if taken over by the city. Henrici, Kent & Lowry, Commerce Building, Kansas City, Mo., are engineers.

HIAWATHA, KAN.—Plans, it is reported, have been prepared for the installation of an additional generator in the municipal electric-light plant, and also to supply electrical service to the town of Highland.

INDEPENDENCE, KAN.—Preparations are being made by the Western States Portland Cement Company for rebuilding its power plant, recently destroyed by fire. The cost of plant is estimated at $100,000.

NORWICH, KAN.—The Council has granted the Western Sumner Light & Power Company of Argonia a franchise to supply electricity in Norwich, subject to the approval of the voters.

SPRING HILL, KAN.—Bonds to the amount of $4,000 have been voted for the installation of a municipal electric-light plant.

Southern States

McCORMICK, S. C.—The Isolated Light & Power Company of Spartanburg has applied to the Town Council for a franchise to furnish light and power and light in McCormick.

FAYETTEVILLE, GA.—An election will soon be held to submit the proposal to issue $15,000 in bonds for improvements to the electric-lighting system to the voters.

OLDSMAR, FLA.—The R. E. Olds Company is contemplating the installation of an electric-light plant in the new town of Oldsmar. Ernest R. Holbrook, 200 Lee Street, Tampa, is manager.

STUART, FLA.—Plans are being considered by George W. Parks and associates for the development of a hydroelectric plant near Stuart.

NASHVILLE, TENN.—The Nashville Railway & Light Company is contemplating extensive improvements to its system.

SYRACUSE, ALA.—The City Council has voted to create an ornamental lighting belt in a residential district in the Seventeenth Ward, in Livingston Street, between Euclid Avenue and Strattford Street.

COAL HILL, ARK.—The local electric-light plant, owned by Ferguson & Hicks, recently destroyed by fire, it is reported, will be rebuilt.

HEBER SPRINGS, ARK.—The property of the Heber Springs Light Company has been purchased by the Arkansas Hydro-Electric Development Company of Little Rock, which will enlarge the plant and install new equipment. A. R. Amos, of Little Rock, is president of the Arkansas Company.

IMBODEN, ARK.—The Walnut Ridge & Hoxie Light, Power & Transit Company of Walnut Ridge has completed the erection of a transmission line to Imboden, where it will furnish electrical service. The town has contracted for 15 street lamps.

KENNER, LA.—The City Council is considering the installation of a municipal electric-light plant and waterworks system. Xavier A. Kramer of Magnolia, Miss., is engineer.

MARLOW, OKLA.—The city of Marlow contemplates the installation of an additional generating unit of 250 hp., consisting of an engine and generator, one 100-gal. per minute deep-well pump, one centrifugal pump and about 5 miles of 4-in. mains, valves, hydrants, etc., to cost about $25,000. L. A. Pritchett is superintendent.

MOUNTAIN PARK, OKLA.—The proposal to issue $4,500 in bonds for the installation of an electric-lighting system will be submitted to the voters.

DALLAS, TEX.—The Texas Power & Light Company of Dallas, which now operates more than 300 miles of high-tension transmission lines in Texas, it is reported, is considering plans for further extensions to its system, which include the construction of a large central generating station at Austin, to be followed by extension of transmission lines to San Marcos, New Braunfels and San Antonio. The Southern Traction Company of Dallas contemplates extending its interurban railway from Waco to San Antonio, and this would require a large portion of energy developed at the Austin plant.

GALVESTON, TEX.—The Galveston Electric Company is planning to install a 300-kw. motor-generator set in its plant at Galveston.

GATESVILLE, TEX.—The Gatesville Electric Light & Power Company, it is reported, has awarded contract for the construction of a new building. Entire new equipment will be installed, which will triple the present output of the present plant.

HEMPHILL, TEX.—The Knox Lumber Company is planning to install an electric-light and power plant at East Mayfield, 2 miles distant, and proposes to erect a transmission line to Hemphill to furnish electrical service here. The proposed plant will also supply electricity for lamps and motors in its large lumber mill at East Mayfield.

MIAMI, TEX.—A contract will soon be awarded by the City Council for the installation of an electric-light plant in Miami.

Pacific States

EVERETT, WASH.—A notice of appropriation of certain waters in Glacier Creek has been filed with the county clerk by D. R. Keyes and C. A. Biddle of Everett. It is proposed to divert the water at the rate of 100 cu. ft. per second, to be used to generate electricity for transmission to operate the mines in the Monte Cristo mining district.

NORTHPORT, WASH.—Ground has been broken for the construction of the new electric plant and water-works system in Northport, to be built by C. A. Coffin of Spokane.

PORT ORCHARD, WASH.—The North Pacific Public Service Company has filed its tariff with the State Public Service Commission at Olympia, and announced its intention of laying a submarine cable from Port Orchard to Bainbridge Island to supply electricity in that district.

SPOKANE, WASH.—Petitions are being circulated by property owners on Washington Street, from Trent to Fourth, and on Lincoln Street, from Trent to Third, for the installation of a curb lighting system, similar to the system on West and East Avenues.

PORTLAND, ORE.—The North Coast Power Company is reported to be contemplating improvements to its water system, to cost about $50,000.

RIDDLE, ORE.—Bonds to the amount of $21,000 have been authorized for the installation of a municipal electric-light plant.

ALAMEDA, CAL.—Plans have been prepared by the Union Iron Works of San Francisco for the construction of a power house at its shipbuilding plant in Alameda.

FOREST HOME, CAL.—Application has been made to the State Water Commission for permission to appropriate waters of the north tributaries of Mill Creek, tributary to Santa Ana River, to be utilized to generate electricity for manufacturing purposes for the San Gormgonio power project. The project includes the construction of 5 miles of pipe line and a fall of 2230 ft., generating 6333 hp., at a cost of about $500,000.

HANFORD, CAL.—Arrangements have been made by the Mount Whitney Power & Electric Company of Visalia to take over the electric property and business of the H. G. Lacey Company of Hanford. Mr. Lacey will continue the milling business.

LONG BEACH, CAL.—Work has been started by the Molander Power Company on the construction of power plant at the end of the Long Beach pleasure pier to generate electricity from wave-motor equipment. The cost of the plant is estimated at $25,000.

LOS ANGELES, CAL.—Surveys are being made by W. D'Arcy Ryan of the General Electric Company for the installation of an ornamental lighting system on Broadway.

PASADENA, CAL.—The 33,000-volt, three-phase, high-tension transmission line connecting the cities of Los Angeles and Pasadena is completed. The work was done by the municipal lighting department of Pasadena. A temporary substation at the Pasadena plant is designed to step up the current for transmission to Los Angeles. The city of Los Angeles has carried the line to its station in Garvanza to receive the energy from the new line.

SACRAMENTO, CAL.—Frank M. Ish, of Oakland, has filed a petition with the State Water Commission for permission to use all unappropriated water with a minimum of 100-sec. ft. of the waters of the South Fork of the Merced River, in Mariposa County, to be used to generate electricity. About 10,000 hp. will be developed. The plans provide for a development of 10,000 hp, to cost about $1,500,000. Work will begin on the project in June, 1917.

SAN FRANCISCO, CAL.—The State Railroad Commission has authorized the Sierra & San Francisco Power Company of San Francisco to issue $1,000,000 in bonds to be sold at not less than 85, the proceeds to be used for the following work: Completion of Strawberry dam, $100,000; enlargement of its San Francisco plant, $500,000; extension of distribution lines, $150,000 and $100,000 for the purchase of new properties.

COEUR D'ALENE, IDAHO.—The Central Heating & Lighting Company contemplates the installation of a heating and power plant in Coeur D'Alene, to cost about $100,000.

HAILEY, IDAHO.—The Idaho Exploration Company contemplates the construc-

tion of a power plant to supply power to its Black Barb mines in the Kelly Gulch section.

POCATELLO, IDAHO.—The contract for installation of an incandescent electric-lighting system has been awarded to the Pocatello Electric Company, at $51,513. The contract provides for the use of pressed steel lamp posts.

OATMAN, ARIZ.—The Oatman Hydro-Electric Power Company has been granted a franchise by the Board of Supervisors to operate as a public utility in Mohave County, furnishing electricity in the Oatman mining district and surrounding country.

PHOENIX, ARIZ.—At an election held recently the proposal to issue $600,000 in bonds to establish municipal electric-light and gas plants was defeated.

WICKENBURG, ARIZ.—The town of Wickenburg has sold $17,000 electric-light and water-works bonds. H. P. Ward is town clerk.

MOORE, MONT.—Improvements and extensions are contemplated to the local system of the Montana Power Company of Butte.

POPLAR, MONT.—Bonds to the amount of $6,500 have been voted for the installation of an electric-lighting plant.

WHITE SULPHUR SPRINGS, MONT.—The City Council has approved the transfer of the franchise held by Robins & Meyers Electrical Company to M. Hover of Saco, who proposes to take over the local plant and make extensions and improvements to the system.

CREEDE, COL.—The Commodore Mining Company, it is reported, is making arrangements to install a power plant in connection with its property, located on West Willow Creek.

Canada

VICTORIA, B. C.—The Couteau Power Company, which proposes to construct a hydroelectric power plant on the Shuswap River, has again been granted an extension of time, which gives the company until Aug. 28, 1917, to begin work on the project and until Aug. 28, 1918, to complete same.

LONDON, ONT.—The townships of South Dorchester, Westminster and Dereham will submit by-laws to ratepayers in January to provide $1,000,000 for construction of the proposed hydro-electric railway project.

SAULT STE. MARIE, ONT.—The installation of two motor-driven pumps of 5,000,000 gal. capacity each is under consideration by the City Council.

SHERBROOKE, QUE.—The City Council has awarded the contract for construction of transmission line from the power station at Weedon to Sherbrooke, a distance of about 30 miles, to the Two Mills Falls Power Company of Weedon, Que., at $500,000. Energy transmitted over the proposed line will be used for industrial purposes in Sherbrooke.

GRAND COULEE, SASK.—The local electric-light plant was entirely destroyed by fire recently. W. Young is secretary and treasurer.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until Nov. 21 for furnishing steel billets, soft steel, steel cable, etc. Blanks and general information relating to this circular (No. 1099) may be obtained from the above office or the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and Fort Mason, San Francisco, Cal.

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until Dec. 2, for furnishing dredge tumbling, engine truck springs, brake shaft brackets, lamp posts, electric cable, wire, conduit and fittings, etc. Blanks and general information relating to this circular (No. 1100) may be obtained from the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans,, La., and Fort Mason, San Francisco, Cal.

Recent Radio Patents

Notes and Comments on United States Patents on Radio Signaling and allied topics issued during October, 1916.

1,200,210. TRANSMITTER FOR ETHERIC OR WIRELESS TELEPHONE SYSTEMS; F. H. Millener, Omaha, Neb. App. filed Nov. 7, 1912; issued Oct. 3, 1916. A multiple microphone arrangement for transmission of speech. Combines a number of telephone transmitters with a single mouthpiece and an amplifying sound chamber or megaphone.

1,200,470. THERMIC TELEPHONE; P. de Lange and R. A. B. van Lynden, Utrecht, Netherlands. App. filed Nov. 4, 1915; issued Oct. 10, 1916. A telephone in which the sound response is produced by the rapid expansion and contractions of a fine wire through which the signal current is passed. This instrument is of interest to radio engineers in that it possesses considerable sensitiveness and is capable of direct operation by the received radio-frequency currents, without the interposition of a detector or rectifier.

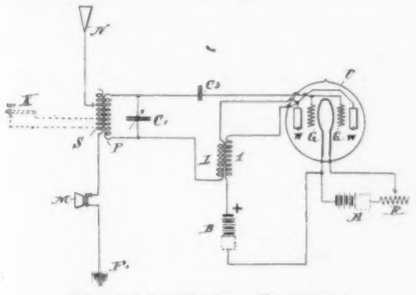


Fig. 1—Oscillation Generator

1,200,471. THERMIC TELEPHONE; P. de Lange and R. A. B. van Lynden, Utrecht, Netherlands. App. filed Nov. 4, 1915; issued Oct. 10, 1916. A thermal,expansion telephone receiver of the sort described immediately above, but in which the sensitiveness is increased for some particular sounds by making the air chamber resonant.

1,200,815. DEVICE FOR AMPLIFYING THE EFFECT OF SOUND WAVES; W. H. Cotton, Chicago, Ill. App. filed Dec. 11, 1911; issued Oct. 10, 1916. A magnifying sound chamber for telephone receivers, having parabolic form.

1,200,900. JET APPARATUS; A. F. Sykes, New Barnet, England. App. filed June 19, 1916; issued Oct. 10, 1916. A liquid jet recording device in which the incoming energy produces a magnified deflection of the conducting jet and thus affects an indicating instrument.

1,201,034. ART OF UTILIZING HERTZIAN WAVES; Edwin R. Gill, Yonkers, N. Y. App. filed Jan. 29, 1914; issued Oct. 10, 1916. A recording receiver for radio telegraph messages, in which the incoming waves are impressed upon acoherer which is then "developed" or put through a process giving an amplified effect upon the detector. The "developed" coherer is next placed in a recording instrument circuit, and finally decohered so as to be ready for the next wave. A number of coherers are used, so that at least one is ready for receipt of signals at all times.

1,201,270. OSCILLATING CURRENT GENERATOR; Lee de Forest, New York, N. Y. App. filed Sept. 14, 1914; issued Oct. 17, 1916. An audion generator of oscillations having a variable resistance and shunt capacity connected between the grid and filament, for the purpose of increasing the amplitude of the alternating currents produced. An oscillation circuit is connected between the grid and plate.

1,201,271. OSCILLATING AUDION; Lee de Forest, New York, N. Y. App. filed July 22, 1915; issued Oct. 17, 1916. Mercury-sealed, double-walled vacuum tube containing hot and cold electrodes, for the generation of oscillations of high power. The surrounding mercury acts both to retain the vacuum and to carry off the heat generated in the operation of the bulb.

1,201,272. TELEGRAPH AND TELEPHONE RECEIVING SYSTEM; Lee de Forest, New York, N. Y. App. filed Sept. 27, 1915; issued Oct. 17, 1916. An audion detector in which the plate circuit voltage is supplied from a potentiometer connected across a direct-current source. Condensers, ground connection and impedance coils are provided to eliminate or reduce interfering noises from the dynamos, etc., to which the potentiometer is connected.

1,201,273. OSCILLATION GENERATOR; Lee de Forest, New York, N. Y. Orig. app. filed May 13, 1915; div. filed Dec. 28, 1915; issued Oct. 17, 1916. An audion-type electron or vacuum relay possessing a plurality of grid and wing electrodes. The grid and wing circuits are electromagnetically coupled for the generation of electrical oscillations.

1,202,168. ELECTROMAGNETIC WAVE RECEIVING SYSTEM; Edwin B. Dallin, Arlington, Mass. App. filed Aug. 14, 1915; issued Oct. 24, 1916. A receiving tuner in which the grounded aerial circuit is not directly coupled to a tuned circuit associated with the detector. An open circuit containing two inductances serves to transfer the received energy to the indicator circuit, one coil being coupled to the aerial inductance and the other to the detector system.

1,202,925. AUTOMATIC RECORDING SYSTEM FOR RADIO TIME SIGNALS; Frank D. Urie, Elgin, Ill. App. filed Dec. 19, 1914; issued Oct. 31, 1916. A receiver which records incoming time signals and permits their comparison with the time of a local clock. In order to cancel the effect of the lag in relays and amplifiers at the receiver, the local clock is caused to produce oscillations which affect the original detector.

1,203,064. TRANSMITTING APPARATUS FOR WIRELESS TELEGRAPH AND TELEPHONE SYSTEMS; Frederick G. Simpson, Seattle, Wash. App. filed Nov. 16, 1915; issued Oct. 31, 1916. A direct-current generator of substantially undamped oscillations. Has a mercury rectifier connected in the power line supplying the spark gap, for the purpose of preventing discharge of oscillating energy through the dynamo, and to suppress arcing at the spark gap. The spark gap is contained in a trigger circuit which is conductively and inductively coupled to the antenna or oscillating circuit.

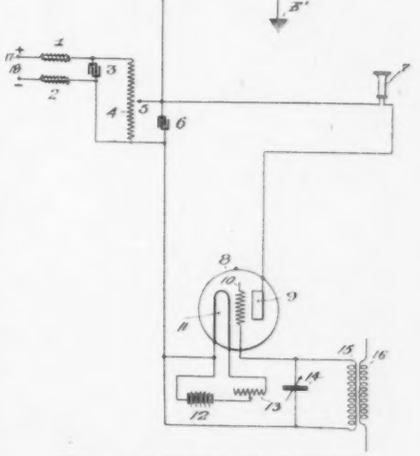


Fig. 2—Telegraph and Telephone Receiving System

1,203,190. RECORDING AND REPRODUCTION OF PULSATIONS OR VARIATIONS IN SOUNDS AND OTHER PHENOMENA; Charles E. Fritts, New York, N. Y. App. filed Oct. 22, 1880; issued Oct. 31, 1916. A phonograph or signal recording instrument operating by varying light beam thrown upon a sensitive film. The negative thus produced is passed before a selenium cell or similar device, for reproducing. By using a stronger light for reproducing than for recording, an amplified effect is had.

DISCUSSION.

The number of radio patents, or patents of particular interest to radio engineers, issued in each month by the United States patent office, has been steadily increasing. In the ELECTRICAL WORLD for the third Saturday of each month there have been appearing reviews of the technical disclosures of these specifications; for the month

of July, nine were digested. For August and September the numbers were eleven and twelve, respectively, while for the month of October, 1916, fourteen patents are treated. As in the last previous discussion, patents which involve the use of audions or electron relays seem to be the most interesting and significant.

De Forest's patent, No. 1,201,273, which is one of a group of four issued to the same inventor on Oct. 17, is limited in its claims to a multiple grid and plate arrangement, but shows a circuit arrangement which is worth considering. Fig. 2 of the specification is shown as Fig. 1 herewith, and represents an audion oscillator used as a source of continuous radio frequency currents for transmission of wireles telegraph or wireles telephone massages. The bulb or audion itself is shown at V, and its wings and grids at W, W, and G, G, respectively. The heating battery A has control resistance R in series, and the plate circuit battery B has in series with it the inductance 1. An oscillation circuit comprising the primary P and variable condenser C_1 is associated with the plates through coil L, which is coupled to 1, and with the grids by way of the condenser C_2. P is coupled to a secondary, S, included in the circuit from aerial N to ground F. A microphone transmitter, M, is used to impress amplitude variations, corresponding to spoken sounds, upon the continuous waves generated by the audion, when the outfit is used for radiotelephony. For telegraphing, a key, K, serves to detune the antenna circuit and thus to alter the amplitude of radiation in accordance with Morse dots and dashes.

The patentee does not attempt to give a complete explanation of the mode of operation, but expresses the opinion that continuous oscillations are generated by the inductive effect of successively applied surges of potential upon the grids and plates, which momentarily affect the conductivity of the medium within the tube in such manner that the action is self-sustaining.

Fig. 2 shows the drawing from de Forest patent No. 1,201,272, which discloses a potentiometer control for the voltage applied to the plate circuit of an andion detector. The use of a high-voltage battery for this purpose has been common in the past, but is inconvenient in many instances. By the plan here suggested any direct current source, such as the ordinary 110-volt lighting line, may be used. It is necessary to provide means for eliminating or reducing the commutator hum and other variations which are ordinarily present on such lines, if the detector combination is to have high effective sensitivenes. In this diagram, the power line is connected to terminals 17, 18, and the iron core inductances 1, 2, and the condensers 3, 6 are used to absorb these variations. The potentiometer itself, 4, should be of from 5000 to 25,000 ohms resistance, and the condensers of from 1 to 2 microfarads capacity. The auxiliary earth connection E' is of further assistance in reducing the interfering noises. As shown, the audion connections are of the well-known normal sort for simple detector action. It is obvious that the same potentiometer scheme may be used for the so-called "ultraudion" or oscillating audion detector for undamped waves, or for the audion generator used for transmitting purposes.

1,203,565. WIRE-CONNECTOR; Oreste Bajma-Riva, Milan, Italy. App. filed Nov. 4, 1915. Device for the mechanical and electrical joining of wires.

1,203,576. TRAINMAN'S FLASHLIGHT; James E. Broadhead, Bay City, Mich. App. filed Jan. 18, 1915. Contains two lights operable by means of a single switch.

1,203,584. CUT-OUT BLOCK; Robert C. Cole, Hartford, Conn. App. filed Nov. 29, 1915. Reduce the cost of manufacture, transportation and installation.

1,203,610. CONTROL SYSTEM AND APPARATUS; Arthur J. Hall, Wilkinsburg, Pa. App. filed April 4, 1914. For operating liquid rheostats.

1,203,635. SUPPORT FOR METALLIC GLOW-FILAMENTS; Anton Lederer, Atzgersdorf, Austria-Hungary. App. filed Sept. 18, 1906. For electric incandescent lamps.

1,203,641. CIRCUIT-CONTROLLER; Ray H. Manson, Elyria, Ohio. App. filed Sept. 29, 1913. For use upon motor cycles.

1,203,650. CEILING-ROSE; Edgar Ison Parkes, Bushey, England. App. filed Oct. 26, 1911. Terminals may be removed for attachment of the conductors.

1,203,664. DRIVING OF ROAD AND RAIL VEHICLES; John G. P. Thomas, Kensington, London, England. App. filed April 7, 1915. Power transmision mechanism on vehicles.

1,203,671. TELEPHONE-EXCHANGE SYSTEM; Samuel B. Williams, Jr., Brooklyn, N. Y. App. filed Sept. 23, 1915. Impulse delivered by the interrupting machine to any secondary magnet will always be of the required duration.

1,203,693. ELECTRIC-CURRENT DISTRIBUTER; William C. Brinton, Jr., Kennett Square, Pa. App. filed Sept. 10, 1915. Closing an electric circuit successively through a number of contact points.

1,203,742. TELEPHONE-EXCHANGE SYSTEM; Lewis H. Johnson, Bloomfield, N. J. App. filed Dec. 1, 1915. Provide improved and simplified signaling means.

1,203,746. ELECTRIC SWITCH; Charles J. Klein, Milwaukee, Wis. App. filed Sept. 7, 1911. Simple and effective mechanism which may be used in snap switches.

1,203,788. FLEXIBLE ELECTRICAL CONDUIT; William C. Robinson, Pittsburgh, Pa. App. filed June 3, 1912. New and useful improvements.

1,203,789. ELECTRICAL COIL AND METHOD OF WINDING SAME; Claes Ryden, Cranston, R. I. App. filed Jan. 30, 1915. Improvements in the method of winding coils.

1,203,790. WINDING-MACHINE; Claes Ryden, Cranston, R. I. App. filed Jan. 30, 1915. Transverse-mechanism of the winding-apparatus.

1,203,810. RHEOSTAT; Lewis L. Tatum, Milwaukee, Wis. App. filed Feb. 21, 1916. Provide a rheostat with readily mountable and demountable resistance units.

1,203,812. MERCURY-VAPOR APPARATUS; Percy H. Thomas, East Orange, N. J. App. filed July 19, 1904. New and useful improvements.

1,203,816. ELECTRICAL CONNECTION; William C. Tregoning, Cleveland, Ohio. App. filed Dec. 9, 1912. Relieve the strain that comes upon the wires or terminals.

1,203,825. CIRCUIT-CONTROLLING DEVICE; Henry E. Warren, Ashland, Mass. App. filed Feb. 12, 1915. Bodily movable member.

1,203,829. TELEPHONE-EXCHANGE SYSTEM; Samuel B. Williams, Jr., Brooklyn, N. Y. App. filed Sept. 13, 1915. Circuit arrangements for selector switches.

Record of Electrical Patents

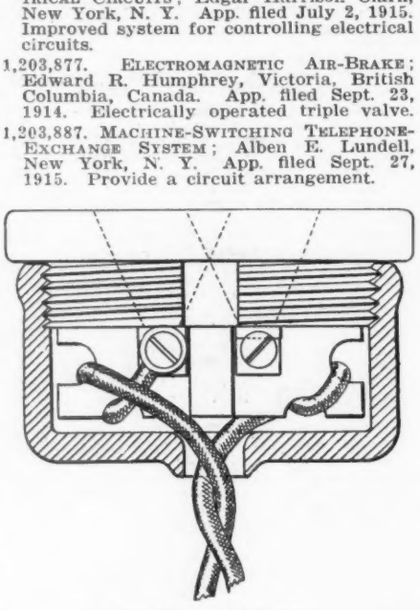
Notes on United States Patents issued on Nov. 11, 1916.

1,203,845. AUTOMATIC TRAIN-STOP; Carl H. Buhl, Cleveland, Ohio. App. filed Oct. 27, 1913. Air brakes applied under danger conditions.

1,203,851. SYSTEM FOR CONTROLLING ELECTRICAL CIRCUITS; Edgar Harrison Clark, New York, N. Y. App. filed July 2, 1915. Improved system for controlling electrical circuits.

1,203,877. ELECTROMAGNETIC AIR-BRAKE; Edward R. Humphrey, Victoria, British Columbia, Canada. App. filed Sept. 23, 1914. Electrically operated triple valve.

1,203,887. MACHINE-SWITCHING TELEPHONE-EXCHANGE SYSTEM; Alben E. Lundell, New York, N. Y. App. filed Sept. 27, 1915. Provide a circuit arrangement.



1,203,650—Ceiling Rose

1,203,908. MACHINE-SWITCHING TELEPHONE-EXCHANGE SYSTEM; John N. Reynolds, Greenwich, Conn. App. filed Sept. 7, 1915. Systems employing line finders for extending calling lines to connecting circuits.

1,203,909. ELECTRIC BAKER'S OVEN; Edward H. Ruckle, Chicago, Ill. App. filed Feb. 27, 1914. Multiple compartment bakers' ovens.

1,203,950. TOLL-TRUNK CIRCUIT; Charles S. Winston, Chicago, Ill. App. filed Feb. 21, 1913. Provide a universal toll trunk.

1,203,972. ELECTRICAL SWITCH; Morton G. Bunnell, Chicago, Ill. App. filed Sept. 6, 1912. Means provided for holding switch in either open or closed position.

1,203,975. ELECTRICAL HEATER; Frederick E. Carlson, New Britain, Conn. App. filed Dec. 28, 1914. Immersion heater.

1,203,981. TABLE-LAMP ATTACHMENT; James S. Clifford, Weehawken, N. J. App. filed Feb. 9, 1916. Adaptable to vases having necks of different sizes.

1,204,012. SNAP-SWITCH; Monroe Guett, Hartford, Conn. App. filed Dec. 27, 1915. Utilize sheet material throughout the snap-mechanism.

1,204,014. CONTROLLING DEVICE FOR AUTOMOBILES; Julius L. Hecht, Evanston, Ill. App. filed Oct. 31, 1913. Prevents the driving of the car beyond a certain predetermined speed.

1,204,044. LIGHTING FIXTURE; Harrison D. McFaddin, East Orange, N. J. App. filed July 7, 1915. Support a lamp shade or globe.

1,204,117. MERCURY-VAPOR-ARC LAMP; Charles Orme Bastian and Edward Salisbury, London, England. App. filed Aug. 25, 1904. Comprises an exhausted or any other suitable chamber for containing mercury.

1,204,136. TELEPHONE APPLIANCE; John L. Creveling, New York, N. Y. App. filed July 27, 1908. Means for rendering impulses emitted by an ordinary telephone receiver.

1,204,146. AUTOMOBILE; Roland S. Fend, Chicago, Ill. App. filed June 26, 1915. Combined electric and gasoline motor-driven vehicles.

1,204,104. IGNITION MECHANISM FOR INTERNAL-COMBUSTION ENGINES; Ernest C. Wilcox and John F. Cavanagh, Meriden, Conn. App. filed Jan. 14, 1916. Simplify and improve the construction.

1,204,155. ELECTRICAL SYSTEM OF DISTRIBUTION; Albert S. Hubbard, Belleville, N. J. App. filed Jan. 25, 1910. Improvements in electrical systems of distribution.

1,204,160. ELECTRICAL SYSTEM OF DISTRIBUTION; John W. Jepson, Depew, N. Y. App. filed Jan. 25, 1910. Improvements in electrical systems of distribution.

1,204,169. METHOD OF SYNCHRONIZING; Carl A. Lohr, New York, N. Y. App. filed May 27, 1907. Means for synchronizing synchronous electric motors (or generators).

1,204,185. ELECTRIC PACK; Henry Perlman, Philadelphia, Pa. App. filed March 17, 1914. Distance between the sides may be varied considerably without materially reducing the height.

1,204,214. SIGNAL-RECORDER; Lee J. Voorhees, Binghamton, N. Y. App. filed June 3, 1914. Positive in action, requiring minimum operative energy.

1,204,215. SIGNAL-BOX; Lee J. Voorhees, Binghamton, N. Y. App. filed Feb. 23, 1915. Signal boxes to be more economically manufactured.

1,204,234. APPARATUS FOR THE ELECTROLYTIC MANUFACTURE OF LIGHT METALS AND REACTION PRODUCTS THEREOF; Edgar Arthur Ashcroft, London, England. App. filed March 12, 1912. Efficient and economical manner.

1,204,290. ELECTRIC MOTOR; Wilheim Luyken, Essen-on-the-Ruhr, Germany. App. filed Dec. 13, 1913. Transforming a periodically variable motion of low energy into one of greater energy.

1,204,327. ALARM-CONTROLLING MEANS FOR SPRINKLER SYSTEMS; Nathan H. Suren, Needham, Mass. App. filed Jan. 28, 1915. Indicating the flow of water.

1,204,349. ELECTRIC-ARC FURNACE; Carl Olaf Anderson Doyle, Notodden, Norway. App. filed Jan. 10, 1914. Electrodes have special bracings to reduce vibrations.

1,204,377. POLYPHASE-CURRENT-LIMITING REACTANCE-COIL; John F. Peters, Edgewood Park, Pa. App. filed July 3, 1914. Protective means for electrical apparatus.